Bulletin 271
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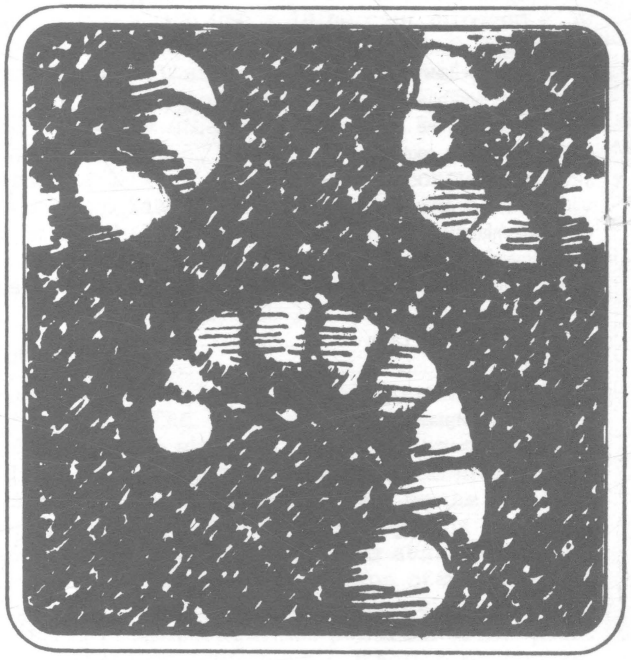
YOUR

LAWN



OSU Cooperative Extension Service
The Ohio State University

IMPORTANT

Due to the continuous introduction of new chemical compounds, discontinuance of various ones now in use, and frequent changes in specific pest control recommendations, pest control measures mentioned in this publication, Bulletin 271, Your Lawn, are very general and pertain primarily to causes, symptoms, and timing of treatments rather than specific compounds to use.

For recommended chemicals, a companion publication, entitled Leaflet 187, Control of Turfgrass Pests, is available through your Cooperative Extension Service (County Agent's) office or direct from The Ohio State University. L-187 lists specific chemical compounds for control of turfgrass pests—weeds, diseases, and insects.

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For Sale Publication

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CARING FOR YOUR LAWN

Bluegrass Blends and Mixtures

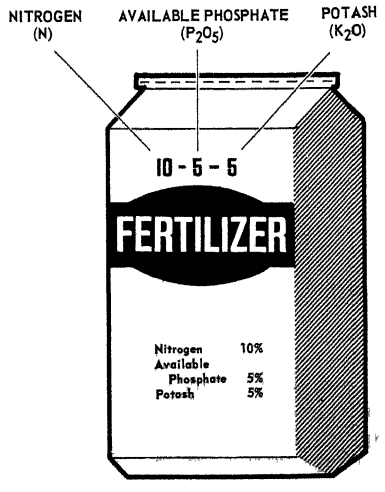
Most lawns in Ohio should be seeded or sodded to Kentucky bluegrass blends (i.e., 3 or 4 bluegrass varieties) or mixtures of bluegrass and fine fescue, bluegrass and perennial ryegrass or bluegrass, fine fescue and perennial ryegrass. These grasses can provide a quality lawn, given good soil conditions, proper fertilization, mowing and pest control. Maintenance practices and pest problems will be covered in this bulletin. Information on turfgrass selection and establishment practices are covered in **separate Home, Yard and Garden fact sheets.**

Fertilizer and Lime

Lawns need regular fertilization to result in quality turf. A reliable soil test is helpful in planning your turf fertilization program, particularly where low levels of phosphorus and/or potassium occur. The fertilizer program described in this section will normally provide sufficient phosphorus and potassium.

Choosing a fertilizer program will depend on the soil conditions, the type of grass present, and the amount of time and effort spent on the lawn. The proper use of nitrogen is the most important phase of the fertilization program for most lawns.

Both specialty lawn fertilizers and farm brands may be used with good results. The forms of nitrogen in farm brands are more likely to burn the grass than are some specialty fertilizers, but with reasonable care, burn is not a serious problem. Some farm granulated or pelleted fertilizers are hard to disperse through some lawn spreaders, but may work better in the rotary types spreaders.



State law requires that all fertilizers be properly labeled. The figures on the fertilizer bags indicate the percent nitrogen (N), phosphate (P_2O_5), and potash (K_2O) in the fertilizer. This is called the analysis. The analysis is always listed although it may be very inconspicuous. Additional information such as the source of nitrogen and other nutrients claimed is often included.

READ THIS INFORMATION. It tells you whether you are getting the fertilizer you want and need.

Fertilizer Analysis

Grass should be fertilized with nitrogen, phosphorus and potassium. Choose a fertilizer with the proper ratio of each of the nutrients to correspond to the soil test results. The fertilizer label must state the percentage by weight of nitrogen, phosphorus and potassium in that order. A 20-10-10 fertilizer has the mineral elements in the ratio of 2 parts of nitrogen, 1 part of phosphorus and 1 part of potassium (2-1-1); so does a 10-5-5. The difference is that weight for weight the 10-5-5 contains ½ as much fertilizer value as the 20-10-10 and twice as much would have to be used for the same results.

A 100-pound bag of 10-5-5 fertilizer contains 10 pounds of actual nitrogen (100 lbs. × 10 percent nitrogen = 10 lbs.), 5 pounds of actual phosphorus (100 lbs. × 5 percent phosphorus = 5 lbs.), and 5 pounds of actual potassium (100 lb. × 5 percent potassium = 5 lbs.). The amount of nutrients in any other fertilizer can be determined in the same way.

Generally a 3-1-2 or a 4-1-2 ratio is considered best for use on Ohio lawns. The ratio need not be exactly a 3-1-2 or 4-1-2. For example, a 24-6-6 analysis approaches a 4-1-2 ratio and a 10-3-7 grade is close to a 3-1-2 ratio. Substitutions of this type can be made without concern.

Types of Nitrogen

How do you choose between products with the same nutrient content? The big choice is between fast and slow release of the nitrogen fraction. The percentage of the total nitrogen that is water insoluble and that which is water soluble usually is listed on the fertilizer bag. In water soluble form, the nitrogen is available quickly, and in the insoluble form it is available slowly.

A good turf fertilizer contains some of each kind of nitrogen. The slow release portion provides nitrogen over a period of time but is not available to the plant during cool weather. The soluble fraction or fast release, will provide nitrogen almost immediately after application and during cool weather. Something approaching 50 percent soluble and 50 percent insoluble is suggested.

Water insoluble forms of nitrogen like activated sewage sludge (e.g. milorganite) and synthetic organics (e.g. ureaform, IBDU, and sulfur-coated urea) are found

in several lawn fertilizers. These materials break down slowly so that nitrogen becomes available to the grass gradually. Although more expensive per pound of nitrogen than the water soluble forms, the water insoluble forms provide a greater margin of safety because they do not readily cause chemical burn or injury to grass. In addition, the gradual release of nitrogen provides a more uniform turfgrass growth rate. Table 2 describes five general types of nitrogen fertilizers that are useful under the various conditions described.

Fertilizer Programs for Bluegrass

Nitrogen is the fertilizer nutrient to which turfgrasses are most responsive. Nitrogen can usually do more to improve lawn quality than any other nutrient. Nitrogen produces the green color and plant density (grass thickness) necessary for good quality lawns.

Table 1 lists some examples of five major groups (similar ratios) of fertilizers from which to choose one for your lawn maintenance program. The rates of nitrogen listed are for fertilizers containing 25 to 50 percent slow release (water insoluble) nitrogen.

For improved Kentucky bluegrasses (e.g. Adelphi, Baron, Bonnieblue, Glade, Columbia, Eclipse, Mystic and others) apply fertilizer at each of the dates listed in Table 1. Skip the April 1 to May 1 and August 15 to September 15 applications if your lawn contains Kentucky bluegrass varieties like Park, Kenblue, Delta, Newport or common Kentucky bluegrass.

TABLE 1. Pounds of Fertilizer to Apply per 1,000 Square Feet

Fertilizers	Oct. 1* to Dec. 1 Per 1,000 sq. ft.	April 1 to May 1 Per 1,000 sq. ft.	May 15 to June 15 Per 1,000 sq. ft.	Aug. 15 to Sept. 15 Per 1,000 sq. ft.
10-6-4, 10 3-7, 10 5 5	15	10	10	10
12-6-6, 12-4-8, 13-3-9, 12 3-3, 12 6-3	12	8	8	8
16-8-8, 15-10-5, 16-8-4, 15-5-5, 16-4-8	10	7	7	7
20-10-10, 20-10-5, 20-8 8, 20-5-5	7 5	5	5	5
23 12 6, 25-5-10, 24-6-6, 23-7-7	6	4	4	4

* Use the earlier date for northern Ohio and the later date for southern Ohio

TABLE 2: Some Forms of Lawn Nitrogen Fertilizers

Type of Fertilizer	Common Name	Approximate Nitrogen Content	Pounds Needed to Supply 1 Pound Nitrogen
1 Soluble, inorganic*	Ammonium sulfate	20%	5
	Ammonium nitrate	33%	3
	Nitrogen solutions	24-32%	3-4
2 Soluble organic forms*	Urea	46%	2 2
3 Insoluble organic forms**	Ureaform	38%	2 6
4 Insoluble organic forms***	IBDU	31%	3 2
	Sulfur-coated urea	32-37%	2 7-3 1
	Methylene ureas	Various	Various
5 Activated sewage sludge**		6%	17

* These soluble and inorganic forms are more effective than organic and insoluble forms when the soil temperature is below 60°F They will burn foliage, if left in contact with it

** The nitrogen in these insoluble organic forms is not readily available unless the soil temperature is above 60°F. They may be broadcast on lawns at any time—at the recommended rates—without danger of burning the foliage Insoluble organic nitrogen fertilizers usually cost more than soluble organic nitrogen or soluble inorganic nitrogen fertilizers

*** Unlike the inorganic forms in category 3, these fertilizers will release nitrogen at cooler soil temperatures Extent of release from methylene urea will depend on exent of insolubility.

Fertilizer Burn

It is safe to broadcast all types of fertilizers on lawns at recommended rates early in the spring, if you apply them before green growth has started. Under these conditions, even without sprinkling, there is no danger of burning the grass. A light burn is unsightly for a week or more but does no permanent damage. Severe burning can kill lawn grasses.

Fertilizers differ in the amount of burn they cause. Ammonium sulfate, ammonium nitrate, urea, and "farm grade" high-nitrogen complete fertilizers are most likely to cause foliage burn.

To avoid fertilizer burn:

- Do not apply more than 1.0 pound nitrogen (N) per 1,000 square feet at one time;
- spread evenly;
- do not overlap or spill fertilizer;
- apply fertilizer only when foliage is dry;
- remember, pulverized materials are more likely to stick to foliage, thus causing burn, than granulated or pelleted materials;
- water immediately after application—this helps to insure against burn;
- use insoluble organic forms of nitrogen or complete fertilizer with the nitrogen composed of these forms; and
- do not apply during stress periods, e.g., high temperature and drought.

Liquid Fertilizers

Many brands and formulae of liquid fertilizers and soluble powders are available. These produce no better results than the same quantities of plant nutrients supplied from dry fertilizers. Liquids may be more convenient for you to apply; however, they may be more expensive than dry fertilizers.

Liming Program

Applications of lime greatly improve the growth and appearance of lawn grasses only where needed. The way to be certain whether or not your lawn needs lime is to have the soil tested. Lime will not reduce the need for fertilizer.

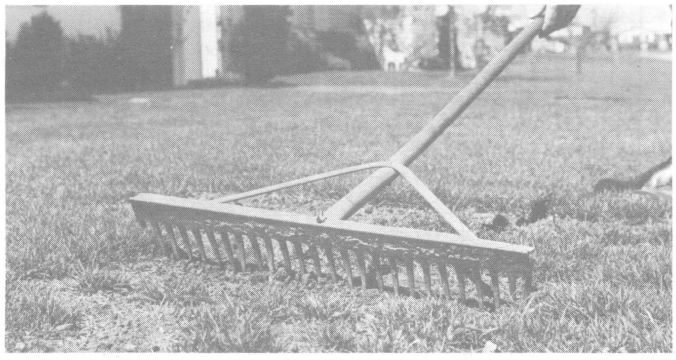
Many simple "quick-tests" are available; however, for a more complete and accurate test, take a sample of the soil to your county Cooperative Extension Service office.

There are great variations in the native lime content of Ohio soils. East of a line from Sandusky to Columbus and Chillicothe, and south of a line from Chillicothe to Hamilton, soils are acid unless they have been limed. North and west of these lines the soils are derived from limestone and are less likely to need lime.

Finely ground or pulverized limestone can be easily applied, is effective, and does not irritate the skin as does hydrated lime. Soil tests every 3 to 5 years determine the lime needs and serve as a check on the liming program. Lime may be applied at any time; however, the best times are late fall or early spring.

Reseeding Thin Lawns and Bare Spots

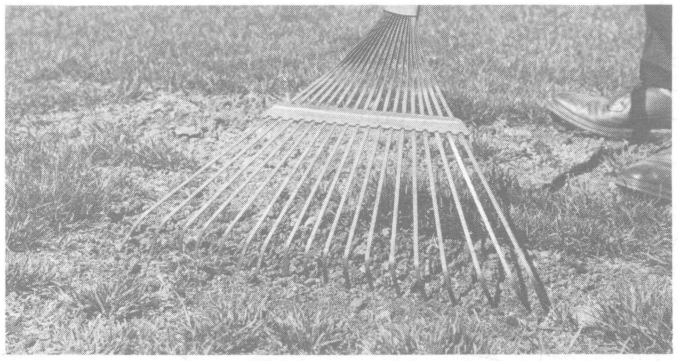
The best procedure to increase the density of a lawn is through proper fertilization and maintenance. Seed added to existing lawns is usually wasted unless it is preceded by cultivation. Dethatching machines can be used to cut grooves into the sod so that the seed may be placed in contact with the soil for more favorable



Prepare seedbed

Apply fertilizer and work into surface of soil

Sow seed of same grass mixture present in rest of lawn



Rake lightly; just cover seed

Firm soil and apply mulch of straw or peat moss

growth conditions. Use the following procedure on thin lawns:

- Mow the lawn
- Selectively cultivate to slice through the sod (e.g., dethatching machine)
- Spread quality seed uniformly
- Rake or drag to place seed in grooves
- Irrigate regularly until established

Bare areas of about six inches or more in size may be reseeded by raking, spreading seed, lightly raking again and keeping it moist. A similar grass mixture to that prevalent in the lawn should be used. Pieces of sod taken from inconspicuous areas and placed in small bare spots may be better than seed.

Lawn Mowing

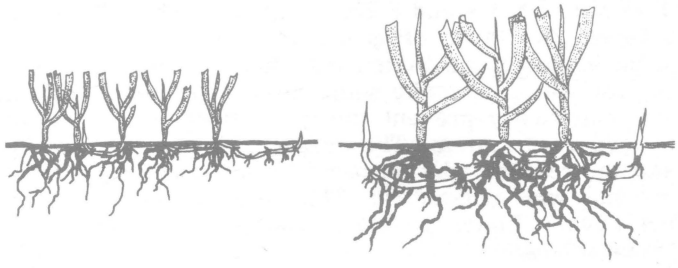
A quality lawn requires regular mowing at the correct cutting height with suitable equipment. Proper mowing is essential to developing and maintaining a dense, uniform surface and can effectively reduce the number of weeds that may invade a lawn.

Selecting the correct mowing height depends primarily on the species of grasses in the lawn. The appropriate cutting height for common lawn grasses are as follows:

Grass	Cutting Height
Kentucky bluegrass	1½-2½″
Fine fescue	2-2½″
Perennial ryegrass	2-2½″
Tall fescue	2½-3″
Zoysiagrass	½-1″

Turfgrass, like other plants, must manufacture sugars through the process of photosynthesis if they are to survive and grow. This process occurs mainly in the leaves of the plant. Turfgrasses cut at low heights cannot sustain the rate of photosynthesis necessary to produce enough food to maintain plant vigor. The short mowing height weakens the turf and increases its susceptibility to weed invasion, insect damage and injury from drought and temperature extremes.

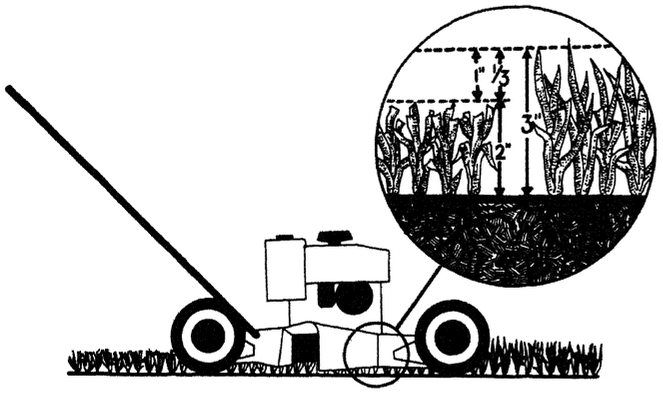
It is advantageous to raise the cutting height slightly



Lower than recommended mowing heights for a grass species or variety result in a reduction in root growth and overall plant vigor.

in the summer. Higher cutting heights increase the leaf surface area available for food production (photosynthesis) and provide an insulating or shading effect on the basal portion of the plant and soil. Lower cutting heights increase the likelihood of high soil temperature that can result in a browning and death of the root system.

Cutting height and rate of growth, rather than fixed time intervals, should determine mowing frequency. The homeowner should never remove more than a third of the total foliage at any one mowing. For example, if the selected mowing height is 2 inches, the grass should not grow to more than 3 inches before it is mowed. Removing more than a third of the foliage results in an open, stemmy appearance of the lawn, weakens the plant and may reduce root growth.



Never should more than one-third of the grass foliage be removed at each mowing.

Turfgrass Clippings

Clippings **do not** have to be routinely removed from most lawns. Returning leaf clippings results in reuse of plant nutrients and perhaps improved soil structure and water movement through the addition of organic matter. It also reduces the solid waste disposal problem many municipalities have when large quantities of clippings are removed. Finally, returning clippings reduces the time and effort needed for mowing.

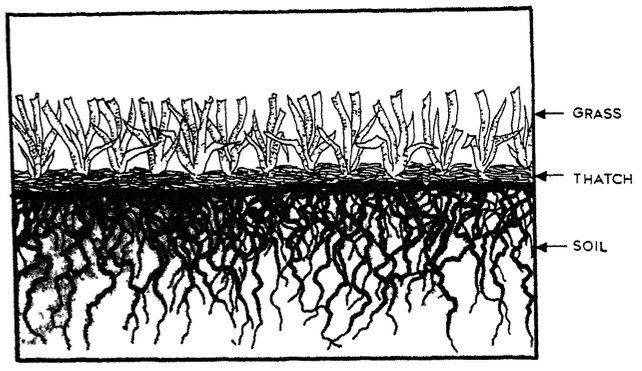
It may be desirable or necessary to remove clippings anytime there is an excessive quantity and an aesthetic problem. This may occur following heavy nitrogen fertilization, heavy rainfall, or anytime the desired mowing frequency is not followed. Proper mowing frequency will result in short clippings that quickly disappear in the turf canopy and eliminates the need for removal.

Other Lawn Practices

Controlling Thatch

Thatch is a tightly intermingled layer of living and dead stems, roots and leaves of grasses which develops between the layer of green vegetation and the soil surface. Too much thatch may keep water from penetrating the soil, make some disease problems worse, and apparently prevent the grass from putting down a deep root system. The reasons for thatch build-up and the reasons why its presence often causes trouble are not well understood. Thin, unfertilized lawns do not have a thatch problem. Thatch is an ailment of "good lawns."

Grasses differ in their inclination to develop thatch. Bentgrass, Merion Kentucky bluegrass, and red fescue



Thatch is an organic layer that develops between the soil and green vegetation.

are likely to develop a thatch problem unless steps are taken to control it. Common Kentucky bluegrass is less likely to have a serious thatch problem.

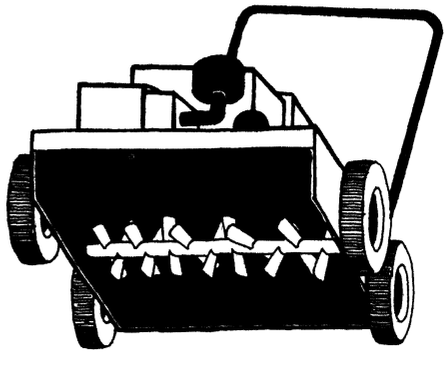
Some factors that encourage build-up of thatch are high mowing (but you should not mow shorter than recommended), heavy fertilization, vigorous varieties, excessive soil acidity, clay soil and infrequent clippings.

The most practical solution to thatch control is the proper use of powered machines (rakes, vertical mowers, etc.) that are designed to remove thatch. Through the annual use of such machines, you can prevent a serious thatch problem. This operation should be done during the cool season of the year when several weeks of good growth and recovery can occur.

Limited experience indicates that early fall is the best time for removing thatch. There are fewer weed problems and two growing seasons (fall and spring) for recovery before the hot, dry summer. Early spring is also a good time for the operation. Machines for removing thatch may be purchased or rented in most larger cities.

Thatch may also be removed with an annual topdressing of about one-eighth inch of good topsoil. The soil buries the thatch and causes it to decompose. Don't topdress with peat or other organic material; this merely adds to the problem. Other maintenance practices which discourage thatch are frequent mowing, adequate but not excessive fertilization, and liming, if needed.

Various products containing enzymes, yeast, bacteria, etc. have been advertised in recent years for thatch control. They have not significantly reduced thatch problems and are not currently recommended.



A vertical mower for extracting thatch. Vertical knives physically extract the thatch.

Rolling

Rolling will not make an uneven lawn smooth. It will bring the surface of a thin lawn to its original level by pushing down bunches of grass which were heaved out of the ground by winter freezing and thawing. This may make the first mowing easier. If rolling is needed, roll the lawn once a year just after the frost has come out of the ground and when the soil is moist but not muddy. A water-weighted roller with half the water has sufficient weight. Good sods do little heaving and are not likely to need rolling.

Aerating

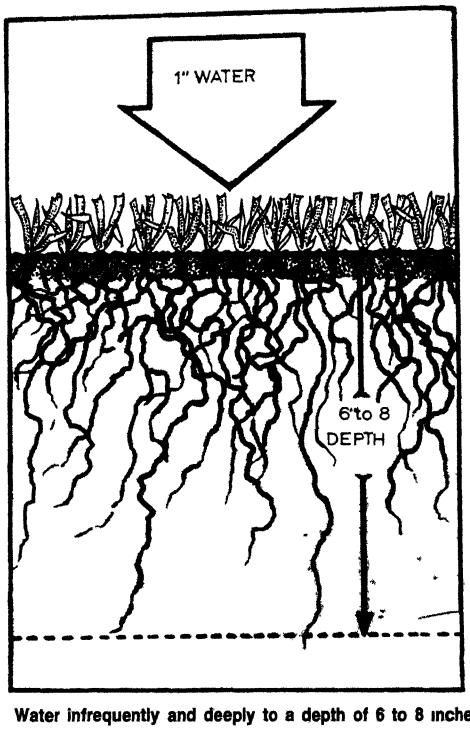
The rate of water intake and penetration on some lawns may be improved by using some type of mechanical aerator. This permits more water to soak into the soil. Areas with tight soils are most likely to be improved. Aerators are of particular benefit on steep slopes and on paths that receive a great deal of traffic.

An aerator that removes a plug of soil is the preferred machine to use. Moist soil is necessary for the satisfactory operation of an aerator.

Lawn Watering

Adequate water is essential for maintaining optimum growth density and color. Natural rainfall is generally adequate during the cool spring and fall periods; however, extended drought periods during summer may cause the grass to wilt and turn brown. Although it may look unattractive, a lawn that is brown and dormant in summer will usually recover with the return of cooler weather.

If a high-quality appearance is desired throughout the season, the lawn should be watered as soon as the grass shows signs of wilting. Apply enough water to moisten the soil to a depth of at least 6 inches. This is roughly equivalent to applying an inch of water. The amount of water supplied can be measured by placing containers within the area covered by the sprinkler.



Water infrequently and deeply to a depth of 6 to 8 inches.

Light, frequent watering leads to deterioration of the lawn because of shallow-rooting and increased disease, weed development, and insect damage. Once a lawn becomes shallow-rooted, it is even more susceptible to water stress. In addition, under a light, frequent watering program the grass develops a more lush soft growth that lowers its tolerance to heat and water stress.

Morning or midday watering is preferred for home lawns. This minimizes disease activity because water remains on the leaf surface for only a short period of time. Late day watering permits free water droplets to remain on the leaf surface for an extended period of time. This increases the potential for greater disease activity. A disease of older or common-type Kentucky bluegrass, called leafspot or melting-out, is more severe with light, frequent and late day watering. Hand sprinkling of the lawn lightly during the evening hours of the summer is one of the major causes of lawn disease problems.

Diagnosing Lawn Problems

When a lawn problem develops, diagnose the trouble before applying corrective treatments.

Brown or Dead Spots

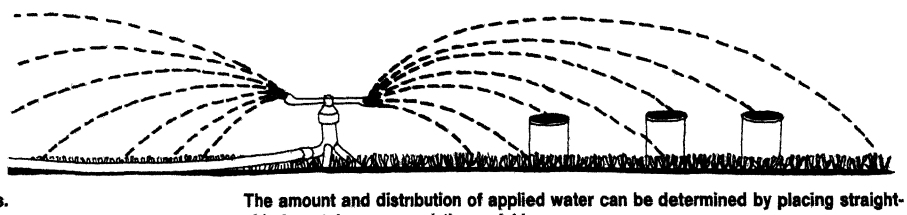
Many lawn problems make their first appearance in spots. The season of the year in which they appear and previous management practices may be clues to the proper diagnosis.

Is it fertilizer burn? When was fertilizer last applied? How much? What analysis? Look for brown spots or streaks where it was necessary to go around trees, shrubs, or other obstacles or where the spreader was turned at the edge of the lawn. A uniform brown cast may be fertilizer burn. A rather low rate may burn if applied when the grass is wet and the fertilizer is not washed off immediately.

Is it a disease? What species is affected? Bentgrass often gets snowmold in winter or early spring. Other grasses may also be affected by snow mold. Bentgrass often gets **dollar spot** in May, June, September, and October. Common Kentucky bluegrass and many varieties get **melting out** (Helminthosporium leaf spot) most seriously in May and June. With serious attacks of this disease, the entire lawn may appear brown after mowing. Some areas of the lawn may be more seriously affected than others. How was the lawn fertilized in the spring? It will be more serious when a high rate of nitrogen was applied in the spring.

Bentgrass may have **brown patch** in July and August. It shows up during hot, humid weather. A black **slime mold** may develop on the grass during wet weather. For positive identification of a disease problem, send a sample to the **Plant Disease Clinic,** The Ohio State University, through your county Cooperative Extension Service office.

Is it insect damage? The various types of white grubs



The amount and distribution of applied water can be determined by placing straight-sided containers around the sprinkler.

(Japanese, May or June beetle) may kill large areas of a lawn. Worst damage shows up in late summer. In effected areas, roots are cut loose and sod can be rolled back to expose grubs. Extensive bird feeding and skunk feeding are signs of grubs being present. **Cutworms and sod webworms** live in the sod and feed on the leaves and stems at night. The worms make a small brown spot by eating circular or irregular areas around holes in which they are hiding. This damage may be mistaken for **dollarspot** because the trouble often occurs on bentgrass. **Chinchbugs** give trouble on bentgrass some years when the weather is hot and dry. Large brown areas, usually circular, result in sunny areas.

Are the dead spots annual bluegrass? It is the nature of annual bluegrass *(Poa annua)* to die during the summer. This may occur suddenly. Dead annual bluegrass is often called "disease." **Redtop** has few basal leaves after it is 2 or 3 years old and may appear brown after mowing. Where it is concentrated, a "brown spot" will appear.

Local **dry spots** may cause brown spots. Punch the affected spots and the adjacent green area with a knife blade, screwdriver, or similar instrument. If the brown spot is hard and the green area soft, a lack of moisture in the brown area is probably the difficulty. Local dry spots develop because of poor soil condition, thatch, fungus mycelium growth in soil, or other unknown causes. Bentgrass patches usually turn brown first in a Kentucky bluegrass lawn.

The improper use of **pesticides** or other chemicals may cause brown spots. Bentgrass spots may be brown from an application of 2,4-D or other chemicals, since bentgrass is more sensitive to injury than other lawn grasses. Herbicides for controlling crabgrass, insecticides or fungicides can cause burn.

Gasoline or other petroleum products will kill grass where they are spilled. Small brown spots may result from over-filling the gas tank on the mower and from gas sloshing out as the mower moves along.

Mowers in poor condition may be the cause of some browning on lawns. A reel-type mower that is dull or has the reel set too far from the bed blade, may crimp the grass instead of cutting it. The dead leaf tips will cause a general browning. A rotary mower that is dull, has some part of the blade other than the cutting edge hitting the grass, or has a blade turning too slowly will cause grass to fray. The grass will show a white cast and then brown on the tips.

Female dogs may cause green or brown spots on a lawn, depending on the time of year and the size of the dog. The larger the dog, the drier the soil, and the higher the temperature, the more damage will be done. Grass not killed in or around the effected spot will turn greener because of nitrogen in the urine.

Moss

Moss and algae are usually present in lawns because conditions are not suitable for growing a dense, healthy turf. Infestations of moss may be associated with dense shade, low fertility, poor air circulation, acid soils or a combination of these conditions.

The above conditions usually result in a thin, low quality turf and may allow the moss to become established. The only permanent control of moss is to correct the unfavorable conditions, initiate a good management program and thereby produce a dense, high quality lawn that will eliminate the moss problem.

Thin, Unthrifty Lawn

Consider the following points if there is a uniformly thin stand of grass and the lawn has a general unhealthy look:

1. Lawn may not be receiving sufficient fertilizer.
2. Lawn may be cut **too short.** Most bluegrass varieties should be cut 2 to 2½ inches high. They may never make a thick sod under short mowing.
3. Use of unadapted grass. If a mixture containing a high percentage of ryegrass is used, it will take time for the permanent grass to fill in after the ryegrass is gone. A good maintenance program should in time make a good lawn out of a thin stand of Kentucky bluegrass. The lawn will need to be reestablished where there is no bluegrass or other permanent grasses present.

Shaded Lawns

Portions of most lawns are subjected to partial shading. Shaded turf is usually less dense, shallow rooted, prone to disease injury and more susceptible to environmental stress. A mixture of shade tolerant Kentucky bluegrass varieties and fine fescue is recommended for lawns having some shade. This mixture should be overseeded where turf in the shade is thin.

Modification of the cultural program may improve turfgrass quality in shaded areas. Suggestions include raising the height of cut, reducing fertilization and irrigation and providing disease control when necessary. In addition, it is very important to prune the lower tree branches to allow maximum light to reach the turf. Tree leaves should be raked and removed quickly during the fall season to increase light reaching the turf.

The establishment of a ground cover may be the only alternative under extremely heavy shade conditions where turf will simply not survive.

Renovating An Old Lawn

Many homeowners are interested in chemically killing the old lawn sod and reseeding a more desirable grass. It is fairly easy to establish new grass once the old vegetation is killed. The mat of dead sod must be removed and a new lawn seeded or sodded.

Experience has shown that the combination of a chemical and a tiller will give better kill of the unwanted plants than either used alone. Any reestablishment operation should be timed so that seeding can be done between September 1 and September 15.

Some of the chemicals used in lawn reestablishment experiments are discussed here:

Roundup: This is a water soluble, non-selective herbicide that causes discoloration in about seven days. Use of Roundup according to label directions followed by selective tillage gives excellent control of most grasses. The outstanding characteristic of Roundup is the short residual which allows sodding or seeding seven days after application.

Amitrol or Amitrol-T plus dalapon: This combination has given more complete kill than either used alone. Excellent results have been obtained when used ahead of cultivation. The kill is relatively slow and a waiting period of four to six weeks before seeding is advisable, due to the soil residul of dalapon.

Amitrol-T: The kill of vegetation is relatively slow but quicker than with amitrol. Some deep-rooted perennial grasses and bentgrass usually escape when only one application is used. There appears to be little soil residual, and seeding of Kentucky bluegrass made one week after treatment has been successful.

Bentgrass

Bentgrass lawns may become established by accident, or you can get a bentgrass lawn by planting it. Most homeowners are not willing or able to make the effort needed to produce a fine quality bentgrass turf.

To obtain a bentgrass lawn, (1) sow seed, (2) plant stolons or sprigs, or (3) sow a lawn mixture that contains some bentgrass seed. Bentgrass in a mixture will crowd out other grasses.

The homeowner who plants bentgrass should understand, however, that good management is needed to maintain it. Bentgrass is in many lawns where bluegrass is the intended and desired grass. Bentgrass in bluegrass often appears as spongy patches which usually become brown or unsightly in the summer. When bentgrass has invaded a bluegrass lawn, there are two courses of action:

1. Treat it as a bentgrass lawn.
2. Kill the bentgrass with chemicals and reseed.

Removing Bentgrass from Infested Bluegrass or Fescue Lawns

Bentgrass can be killed by the proper use of a nonselective herbicide such as those described in the "Renovating an Old Lawn" section on page 7. This must be followed by reseeding or resodding.

Managing a Bentgrass Lawn

If you decide you want a bentgrass lawn after purposely seeding it or discovering that it has "taken over," you should manage it as explained in the following paragraphs.

Fertilizer and Lime

Bentgrass requires a high level of fertilization for the carpet-like lawn that it is capable of making. Experiments have shown that bentgrass clippings contain about 3 parts of nitrogen (N) to 1 part phosphate (P_2O_5) and 2 parts potash (K_2O). Replace these fertilizer elements in about a 3-2-1 ratio, once the soil is adequately supplied with phosphorus and potash. A soil test is advisable for determining specific fertilizer needs. See page 3.

Fertilizer Program for Bentgrass

Bentgrass needs 5 to 7 pounds of nitrogen per 1,000 square feet per season along with some phosphorus and potash. The nitrogen must be applied periodically throughout the season. Soluble nitrogen must be applied cautiously, because bentgrass is easily damaged. Several fertilization plans can give equal results. Suggested ones are:

Plan A—Apply 12-3-6, 10-3-7, or similar analysis at the rate of 10 pounds per 1,000 square feet (about 1 lb. of actual nitrogen) each month, April through October. Apply twice as much nitrogen using half the number of applications, if all the nitrogen is from Ureaform. Make comparable adjustments when only a part of the nitrogen is from Ureaform.

Plan B—Apply soluble or readily available organic nitrogen at the rate of 1 pound of actual nitrogen per 1,000 square feet each month, April through October. If you use Ureaform nitrogen, make 3 applications at the rate of 2 pounds of nitrogen (about 13 pounds of 38% material) per 1,000 square feet per application, 1 in early September, 1 in April, and 1 in July. Supplement the nitrogen with 4 pounds of muriate of potash (0-0-60) per 1,000 square feet in the spring and 10 pounds of 0-20-20 per 1,000 square feet in the fall.

Plan C—Use the annual treatment suggested for Merion Kentucky bluegrass on page 4. Take care not to burn the grass.

Plan D—Be satisfied with less than the best. Cut the fertilizer in the above plans in half and make fewer applications.

Fertilizer Burn

Bentgrass is more sensitive to fertilizer injury than bluegrass. It is advisable to water the grass immediately after applying fertilizer that may burn. If you apply inorganic fertilizer, do not walk over the area until the fertilizer has been washed off the leaves. More information can be found on page 4.

Liming

The discussion on liming in the bluegrass section (page 4) also applies to bentgrass.

Mowing

Bentgrass should be cut short. The cutting height should be ½ to ¾ inch using a reel type mower. Some lawn mowers cannot be adjusted to cut this short. You may need to mow three or more times a week. It is desirable, but not absolutely necessary, to remove clippings from bentgrass turf.

Controlling Thatch

For a healthy lawn, prevent bentgrass from forming an extremely heavy thatch of unrotted stems, leaves, and roots which will create a spongy condition. This thatch is heavier when bentgrass is mowed high; however, you will not necessarily avoid the difficulty by short mowing. See page 6 for more information on thatch.

Topdressing

A light (about one-eighth inch) annual application of good topsoil or sand will serve to level the lawn surface and will go a long way toward controlling thatch. You may apply some of the needed lime or fertilizer by mixing it with the topdressing. Use weed-free soil for topdressing.

Rolling and Aerating

See the section under "Other Lawn Practices" on page 6 for information on rolling and aerating. Aerators may be more beneficial on bentgrass than on bluegrass lawns. Use an aerator that removes a plug of soil.

Watering

Watering is necessary to have an attractive bentgrass lawn. During dry periods, this may mean watering three times weekly if the root growth is poor. Water thoroughly and as infrequently as possible to encourage a better root system. Unless you have a good water supply, you should not attempt a bentgrass lawn.

WEED CONTROL

NOTE: For recommended chemicals, Leaflet 187, Control of Turfgrass Pests, is available through your County Extension Agent's office or direct from The Ohio State University. L-187 lists specific chemical compounds for the control of turfgrass pests—weeds, diseases, and insects.

Producing a dense, healthy stand of turfgrass is the most satisfactory method of controlling many lawn weeds. Weeds usually will not be a serious problem, if the recommendations in other sections of this bulletin are followed. However, herbicides may be needed to have a completely weed-free lawn. Herbicides are chemicals which kill or reduce plant growth. They do not eliminate the need for good lawn management, but if properly used they can be another tool for obtaining a good lawn.

Herbicides are sold commercially under various trade names in several package sizes. It is more important to consider the proper active ingredient in the herbicide than to consider the specific trade name.

Herbicides are manufactured in different forms or formulations. Granules are designed to be applied in the dry form. Wettable powders and liquids are designed to be mixed with water and applied as a spray. The label on the herbicide container gives directions for mixing and applying the various formulations.

Many types of commercial equipment are available for applying turf herbicides. It is important to get uniform distribution of the correct amounts of herbicide. One of the best sprayers for home use is the hand-operated, compressed-air sprayer with a capacity of one to three gallons.

The simplest way to apply the desired amount of material as a spray is to add that amount to a relatively large quantity of water (1 gallon to 200 to 300 square feet). This is sprayed over the lawn repeatedly until all the solution is used. After the first coverage, it is best to go crosswise to the previous spray pattern each time.

Hand-operated, push-type spreaders are satisfactory for applying granular herbicides. The calibration directions furnished with the spreader or the directions on the herbicide label should be followed. The setting with one of the smallest openings is often required for applying granular herbicides. Apply a given amount of granules to a small area before treating the entire lawn to be sure the setting is correct.

Lawn herbicides are useful and relatively safe but must be handled with respect. **Keep them away from children and out of eyes and food. Avoid drift while spraying. Directions and precautions on the label should always be read and followed carefully.**

Broadleaf Weeds

Broadleaf weeds can be satisfactorily controlled in turfgrass by using herbicides to kill the weeds and good cultural practices to prevent weed reinfestation. This has been proven in practice and in continuing turfgrass studies at the Ohio Agricultural Research and Development Center.

Chemicals which control broadleaf weeds kill actively growing weeds but have little pre-emergence action to prevent weeds seed from germinating. Because weed seed are present in all turfgrass areas, many will germinate and grow unless a dense, healthy stand of grass is established and maintained.

The first step in any successful weed control program is the use of an adapted variety of turfgrass to produce a good dense turf which is relatively free from diseases. A weak turf of a disease-susceptible variety has been found to have significantly increased weed problems, Table 3.

TABLE 3: Effect of Variety, Density, and Leafspot (Helminthosporium spp.) on Weed Population in Kentucky Bluegrass

Variety	Density*	Leafspot**	Percent Weeds
Pennstar	8 9	1 0	1
Merion	9 6	1 7	2
Windsor	7 2	3 5	3
Delta	3 4	5 9	9
Newport	3 4	4 6	10
Arboretum	2 3	7 1	22
Common	2 1	8 6	25

*Rating of 10 indicates densest turf, 1 indicates thinnest
**Rating of 10 indicates most susceptible to leafspot, 1 least susceptible

Seed

Many broadleaf weeds and undesirable annual and perennial grasses are seeded when poor quality seed are used. Certified seed are best for establishing weed-free turf. The Ohio Seed Law allows up to 3 percent of common weeds in grass seed but does require that the label list the weeds and percentage of each in the seed. Undesirable grasses may be present in seed and listed as "other crop." Certified seed, however, are permitted to contain no more than 0.1 percent weed seeds.

Even a low percentage of weed seed in a mixture can create a significant problem, Table 4.

TABLE 4: Number of Weeds Sown per sq. ft. When Grass is Seeded at 2 lb. per 1,000 sq. ft.

	Percent Weeds in Seed		
Weeds	0.5%	1%	3%
Pigweed	12	24	72
Dandelion	3	6	19
Buckhorn Plantain	9	18	55
Annual Bluegrass	12	24	72
Crabgrass	8	17	50

Fertility

A regular fertilization program enables turfgrass to compete successfully with weeds. The best adapted variety without fertilizer is not dense enough to prevent weed seed from germinating and becoming established.

There is a direct relationship between the amount of fertilizer used, within limits, and weed infestation, Table 5.

TABLE 5: Effect of Nitrogen Fertilizer on Weed Content of Merion Kentucky Bluegrass

Pounds of Actual N Per Year	Weeds Per 10 Sq. Ft.
10	0
7	1
5	4
2	8
0	22

Mowing Practices

Although mowing probably requires more time than all other operations, it is one of the most important factors in maintaining a desirable weed-free turf. Removing too much growth at one mowing results in a poor root system, weak turf, and increased weed problems. A general rule is that no more than one-third of the turfgrass leaf should be removed at one mowing. A dull mower also damages grass and may result in more weeds.

Research has shown that the weed content of turf is reduced as the cutting height is increased, Table 6.

TABLE 6: Effect of Mowing Height on Weed Infestation of Kentucky Bluegrass Turf

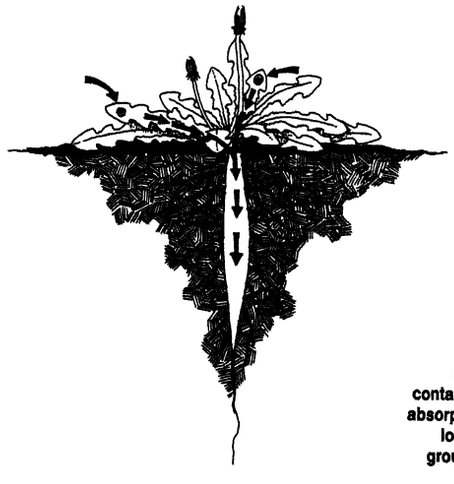
Variety	Weeds Per 10 Sq. Ft.	
	Mowed ¾ In.	Mowed 2 In.
Merion	8	0
Pennstar	10	1
Delta	102	11
Park	105	8
Common	108	5

Herbicides for Broadleaf Weeds

The use of herbicides may be necessary to eliminate all weeds, even in high management turf areas.

Most weed problems encountered in turf involve more than one weed species which means that more than one herbicide may be required for complete control.

Herbicides will kill weeds any time during the season that plants are in an active stage of growth. However, the recommended time for a general herbicide application is during early fall. In the fall, there is less risk of damage to ornamental plants and shrubs and grass has time to fill in bare spots left by killed weeds before crabgrass season the following spring.



A broadleaf weed herbicide requires foliage contact for adequate absorption and translocation to below ground plant parts.

A single fall application of herbicide is probably all that will be required on well managed lawns. However, less vigorous stands of turfgrass which have severe weed infestations may require more than one treatment or perhaps periodic spot treatments of problem areas.

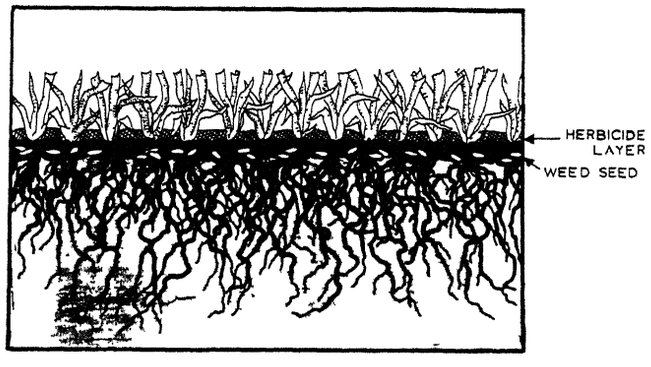
The use of herbicides on newly seeded turfgrass areas should be avoided unless the weed problem is extremely severe. It is usually safe to use herbicides for broadleaf weed control after the grass has been mowed twice.

Annual Grasses

Annual grasses are those which must grow from seed each year. **Crabgrass, foxtail, barnyardgrass,** and **goosegrass** are annual grasses found in lawns. Crabgrass is the most common. Herbicides that control crabgrass usually give some control of the other annual grasses.

There are two basic ways of controlling **crabgrass** with herbicides. One method is to treat the lawn in late winter or spring before crabgrass seed germinate (pre-emergence). The other method is to apply herbicides after the crabgrass is growing (post-emergence). Pre-emergence herbicide applications are preferred for annual grass control.

Pre-emergence herbicides should be applied before crabgrass first germinates. To be sure you apply the materials in time, treat the lawn before April 1 in southern Ohio and before April 15 in northern Ohio.



A pre-emergence herbicide produces a chemical blanket at the soil surface that prevents annual grasses from emerging.

Many crabgrass pre-emergence herbicides are available, and most are in a dry granular form that must be applied with a two-wheel, push-type fertilizer spreader.

Post-emergence crabgrass herbicides should be applied about as soon as the crabgrass is seen in the turf. In Ohio studies, at least two and sometimes as many as six applications have been needed to control crabgrass for the summer. Make applications about a week apart until the crabgrass is killed. Apply another series of treatments if additional crabgrass germinates after the application.

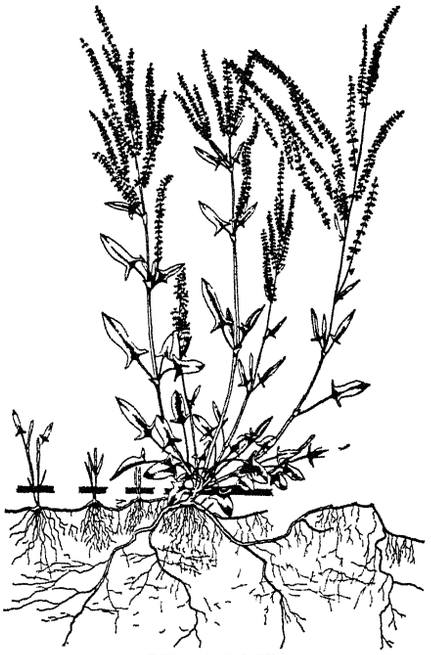
Perennial Grasses

Perennial grasses are those that come back from roots or stems each year. Most lawn grasses are perennials, but there are several perennial grasses which are objectionable in lawns. **Nimblewill** is a summer grass that is quite troublesome in central and southern Ohio. This grass is brown and dead appearing from October through April, hence spots of it give a bare appearance to the lawn in the fall, winter, and spring. In summer it is much like bentgrass.

Tall fescue,, velvetgrass, orchardgrass, timothy, redtop, and **quackgrass** are also undesirable perennial grasses often found in lawns.

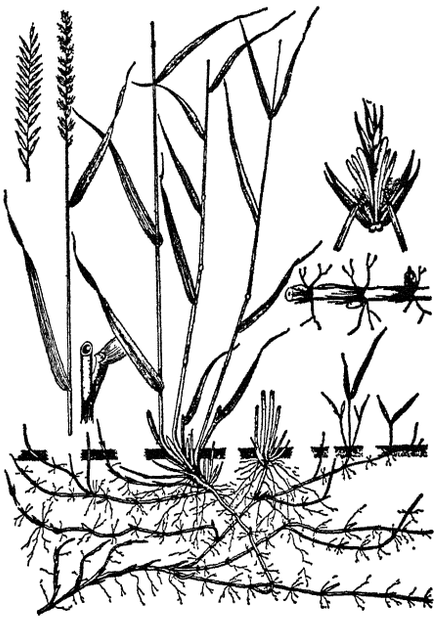
In lawns with sparse infestations, where these perennials are in scattered clumps, the best solution is to remove each clump with a space and replace it with a similar amount of desirable sod taken from a less noticeable place in the lawn. An alternative procedure

would be to fill the dug-out area with soil and then seed a desired turf species. In lawns with heavier infestations where hand removal of the clumps is not practical or where the undesirable perennial grass is not in definite clumps (usually the case with quackgrass), a complete renovation may be the only solution. See "Renovating an Old Lawn" on page 7 for information about chemicals and procedures for renovation.



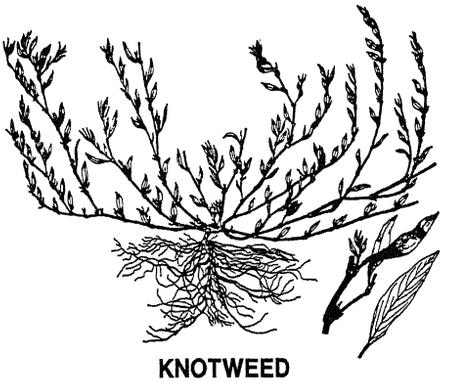
RED SORREL

A perennial that reproduces by seed and underground root-stocks Also known as sheep sorrel and sour docks. Leaves have a characteristic arrow shape and usually have a reddish cast at maturity. Very small flowers are also reddish color.



QUACKGRASS

A perennial grass that reproduces by seed and network of underground stems. Forms a dense sod and thrives under same management practices as a good lawn. Lower leaves, sheaths, and stems are quite hairy. No control by herbicide without killing desirable turf.



KNOTWEED

An annual plant. Reproduces by seed. Commonly found along walks, driveways, and other compacted areas. Often forms dense, close growing mats.

COMMON CHICKWEED

This succulent, fine -stemmed annual weed reproduces by seed and trailing stems. Stems root at lower joints. Leaves arranged in pairs, and flowers are small with five deeply-notched petals.

NIMBLEWILL CRABGRASS

Nimblewill—A shallow-rooted perennial grass that spreads by seed and underground stems. Stems are weak, branched, and spread along or near the soil surface. Leaf blades usually are less than ½ inch wide and not more than 2 inches long. Tops die in autumn, leaving a dense brown mat in the lawn during winter and early spring.

Crabgrass—An annual grass that reproduces by seed. In Ohio, first germinates from late April to mid-May but may continue to germinate throughout summer, if moisture conditions are favorable. Stems are erect or

TALL OR MEADOW FESCUE

arise from a creeping base and usually form mats. Plant produces seed below mowing heights. Usually is purplish color toward end of growing season.

Tall or Meadow Fescue—A forage grass often used on roadsides, playgrounds, and other areas where a tough turf is desired. Commonly found in cheaper seed mixtures. When mixed with bluegrass or other desirable fineturf lawn grasses, fescue is objectionable. It grows in clumps and seldom produces seed under proper mowing practices. It looks much like Kentucky bluegrass but is much coarser.

GROUND IVY

A perennial weed that reproduces by seed and creeping stems. Stems are square-shaped and flowers are purplish color. Commonly found in moist, shaded areas near buildings and shrubbery.

TURFGRASS DISEASES

NOTE: For recommended chemicals and amounts to use, Leaflet 187, Control of Turfgrass Pests, is available through your County Extension Agent's office or direct from The Ohio State University. L-187 lists specific chemical compounds and amounts of each to use in the control of turf pests—weeds, diseases, and insects.

Understanding Lawn Diseases

Kentucky bluegrass, perennial ryegrass and fine fescues comprise the grass species that exist in most of the lawns in Ohio. Although more than 20 infectious diseases have been identified on these grasses, only a few are destructive. In home lawns where there are areas or spots where the grass is dying, thinning out or growing poorly, the first step is to determine the cause.

Diagnostics of infectious lawn diseases are difficult. Many of them do have specific symptoms that can be used in the diagnostic process. The thing to remember in diagnosis is to be aware of the general view and also to be aware of the closeup view of individual grass blades and individual grass plants. Also in diagnosis, we do not want to forget the fact that noninfectious disorders are the most common reasons for lawn troubles. Infectious disease may be causing a lot of trouble in association with one or more of the stress situations.

The two infectious diseases that are most often responsible for dying out of Kentucky bluegrass in home lawns in Ohio are Fusarium blight and the Drechslera (Helminthosporium) leaf blight-melting out complex. Other diseases such as rust, striped smut, powdery mildew, red thread, brown patch and dollar spot are often seen but seldom are so destructive that preventive control practices are necessary.

Managing Infectious Lawn Diseases

When recommended watering and mowing practices are followed and when fertilizers are applied according to soil tests, infectious desease problems are less. Thatch management also is extremely important in keeping these disease problems to a minimum.

Upon learning of the presence of an infectious lawn disease, most people tend to turn to the pesticide shelf in search of a fungicide to solve the problem! This is probably not the best way to approach the management of the disease. Truly integrated health management programs on turf will provide the best way to combat infectious disease.

Fungicides are used by many professional turf managers to manage infectious plant disease in the lawn. Fungicides will be effective if used in preventive programs. The initial applications of the proper products must be timely! Furthermore, they must be applied routinely in spite of the fact that no disease may be present. Few homeowners would be willing to undertake this type of program. In fact, such a program may not be warranted, especially if the disease is not particularly bad year after year.

The application of fungicides to home lawns generally requires specialized equipment. To be effective, most fungicides must be applied to lawns using pressures about 25 pounds per square inch. This requires a power sprayer. Control of Fusarium blight requires an extensive watering before and after application of fungicide materials. Thus, we have additional reasons why chemical treatment for disease control in the home lawn is seldom practical.

Homerowners can combat infectious disease. Emphasis must be placed on proper turf management to prevent or avoid the occurrence of disease problems. Cultural practices will greatly reduce disease and are discussed specifically in the following paragraphs.

Leaf Spot and Melting Out

Cause

This disease is the most damaging disease on bluegrasses in Ohio. It is caused by several species of fungi that were at one time named Helminthosporium. The type of symptom produced is often dependent on the species present. *Drechslera poae* generally results in the melting out phase and *Biopolaris sorokiniana* causes more leaf spotting. However, typical leaf spots can be found on grass blades with all species of the fungus.

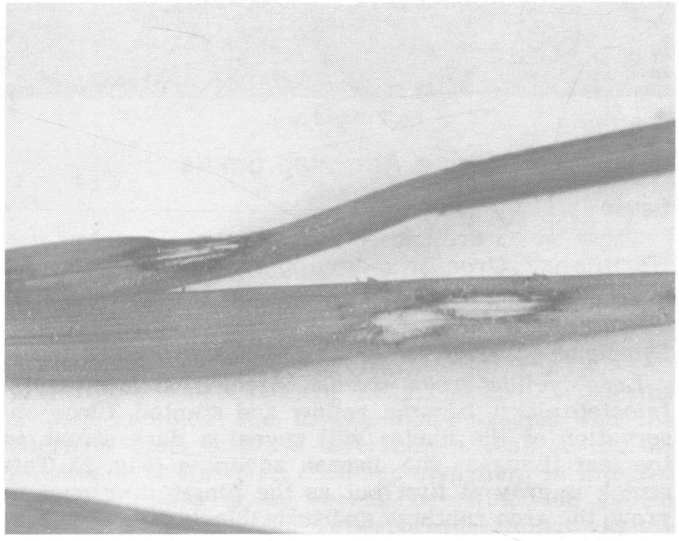
Symptoms

A variety of symptoms may be present. Thinning-out of grass in scattered areas is one sign. A general brownish undercast caused by dead grass leaves accompanies the general thinning-out. Close examination reveals spots on the leaves that are usually brown or purple or brown with a purple border (Fig. 1). They may be round or oblong, generally ¼ to ⅜-inch long and 1/16 to ⅛-inch wide with the centers changing to a dull white color. Most severe injury results when the leaf sheath is infected, leading to crown rot and death of the plants. This is called melting out. Severe leaf sheath infection may thin the stand to less than six leaves remaining per square foot.

Disease Cycle

The pathogen survives the winter in infected plants and infested debris from the previous year's stand. Under moist conditions, spores from the fungus are blown and splashed onto the leaves. The disease progresses from leaf sheath to leaf sheath, killing the above ground parts of the plant.

Leaf spot is more of a problem in early spring and late fall when excessive moisture and cool tempera-



Leaf Spot

tures favor rapid development of the organism. If this is bad in the spring, then melting-out or dying-out of the grass is likely to be bad during the summer. Crown and root rot reduces vigor and drought tolerance of the grass during the summer.

General Control

1. No grass varieties are resistant to all of the melting out fungi. The disease can be found on bluegrasses, bentgrasses, fescues, ryegrasses and bermudagrass. Some bluegrass varieties that show leaf spot resistance are Campus, Prato, Fylking, Pennstar, Baron, Nugget, Sodco and Bensun.
2. Avoid keeping the grass continuously wet with light irrigations. Water to soak the soil to a depth of 6 inches once a week rather than light waterings every day. Do not let the turf dry out or become dormant and then start to water. This favors leaf spot and melting-out. Keep the grass in good vigor during hot weather.
3. Maintain good vigor in the grass but do not over fertilize to promote thatch formation.
4. Mow bluegrass 1¾ to 2 inches high.
5. Consider a protective spray program with effective fungicides to supplement control practices above.

Fig. 2 Striped Smut

Stripe And Flag Smuts

Cause

These smuts are caused by two fungi, *Ustilago striiformis* and *Urocystis agropyri,* respectively. Smut occurs most commonly on bluegrass, bentgrass, fescue and ryegrass.

Symptoms

Long, yellow-green streaks develop in the leaves. Infected plants become yellow and stunted. Close observation of the blades will reveal a dark streak in the leaf tissue as the disease advances (Fig. 2). This streak is gray at first but as the fungus continues to grow, the area ruptures and turns black. It is then that the black soot-like spores rub off and will readily discolor white clothing or shoes. Also at this stage, leaves twist and curl and shread from the tip downward. A cloud of black dust may come from a severely infected lawn when the grass is cut with a power mower. Laboratory diagnosis is necessary to distinguish stripe smut from flag smut.

Disease Cycle

The smut organisms survive the winter months in a dormant state in infected grass plants and as resting bodies (black spores) in the soil or on seed. Spores resume growth in the spring when conditions are favorable for young grass seedlings to grow, generally when temperatures are in the 50-60°F range. After infection, the fungus grows throughout the entire plant, making control difficult. The fungus will remain in the plant until it dies. Infected plants usually die during hot weather. Temperatures above 90°F will retard the growth of the fungi, so the problem is more severe in late spring and in the fall.

General Control

1. Consider resistant varieties. Merion bluegrass is very susceptible to smut. Common and Troy Kentucky bluegrasses are moderately susceptible. Park, Newport, Fylking, Delta, Pennstar, Nugget, and Kenblue are most resistant to the disease.
2. Use clean seed produced by certified growers.
3. Manage diseased lawns on an optimum fertilizer and watering program.

Fusarium Blight

Cause

This disease of turf is apparently caused by two fungi, *Fusarium roseum* f. sp. *cerealis* "Culmorum" and *F. tricinctum* f. sp. *poae*. *F. roseum* appears to be widely distributed in the U.S. Fusarium blight is most troublesome on Merion bluegrass, but other grasses also appear to be susceptible to the disease.

Symptoms

Scattered, light green patches appear first varying from 2 to 6 inches in diameter. After a few days of high temperature, these patches fade to a dull tan and eventually to a light straw color. The patches may be elongate streaks, crescents, or circular patches. In the final stages of the disease, distinct streaks and uniformly blighted, circular patches of diseased grass will be scattered throughout the lawn. Centers of green, apparently healthy grass may occur in the patches of dead grass, giving a frogeye appearence to the area (Fig. 3). During extended periods of high temperature

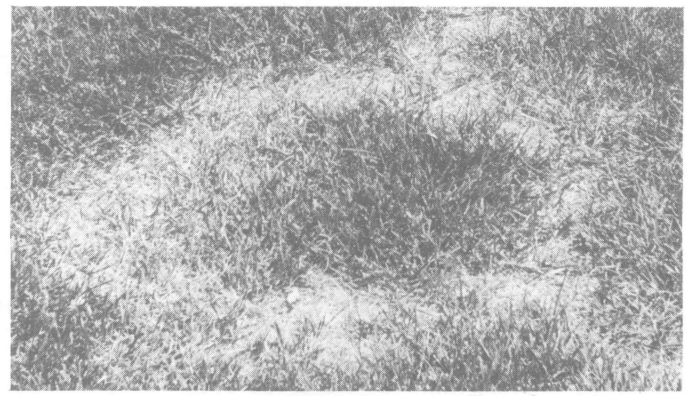


Fig. 3 Fusarium Blight on Merion bluegrass

and humidity, affected areas will run together, resulting in large blighted areas.

Disease Cycle

The fungi that cause this disease survive the winter months in infected grass roots and crowns and in the layer of dead organic matter (thatch) that covers the lower portion of the above ground grass parts. Dry, warm to hot (75-95°F) conditions plus high humidity at the grass level favors disease development. Disease severity appears to be related to heat and drought stresses on bluegrasses. It is usually not observed in heavily shaded areas.

General Control

1. Keep grass growing in a vigorous condition but avoid excessive fertility during favorable periods such as hot periods of summer. Water to avoid stress.
2. Keep thatch to a minimum, as this allows the fungus to overwinter and multiply. Aerate sod to improve water penetration into soil and roots.
3. Consider resistant varieties. Bentgrasses are very susceptible. Bluegrasses such as Adelphi, Bristol, Glade, Parade and Benson are among resistant types. The fescues are most resistant.
4. Use a fungicide program listed in L-187 when above measures fail to give adequate control.

Powdery Mildew

Cause

Powdery mildew is caused by the fungus *Erysiphe graminis*. It is found most commonly on bluegrasses and fescues. The fungus grows largely on the surface of the grass blades.

Symptoms

Isolated wefts of fine, gray-white, cobwebby growth occur mainly on the upper surface of the leaf blade. The growth becomes more dense and the leaves appear to have been dusted with flour or lime (Fig. 4). Infected leaves usually turn white and wither and, in case of a severe outbreak, entire turf areas may be a dull white rather than green.

Disease Cycle

The fungus servives the winter in dead grass leaves or in a dormant state in infected grass plants. Spores spread by air currents can germinate and infect the plant tissue within two hours if ideal conditions are present. These conditions are (a) reduced air movement, (b) high humidity but no water droplets on the surface of the leaves, (c) low light, and (d) 65°F air temperature. Thus, the disease is found to be more severe on turfgrass growing in shaded areas in spring and fall.

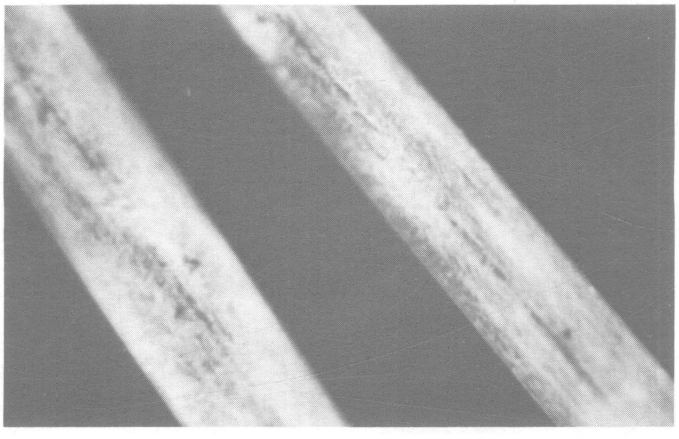


Fig. 4 Powdery Mildew

General Control

1. Use resistant varieties. Glade variety of bluegrass is more resistant to powdery mildew. Merion bluegrass is highly susceptible.
2. Modify the landscape to provide better air circulation and light.
3. Properly prune trees and shrubs to reduce shading.
4. Consider planting ground covers in heavily shaded areas.

Rust

Cause

Rusts are caused by a number of fungus species belonging to the genera *Puccinia* and *Uromyces*. Rust has become common in recent years on many perennial ryegrasses.

Symptoms

Early infection is evidenced by a light yellow flecking of the leaves. As the disease progresses, the turf begins to take on a yellow appearance. The fungus ruptures the surface of the blades and leaf sheath and small reddish-brown pustules are evident (Fig. 5). By this time the turf area takes on a reddish-brown or orange appearance. The rusty material, which is composed of millions of tiny spores of the fungus, will rub off easily onto your fingers, shoes, or trousers. Continuous heavy infections cause many of the grass blades to turn yellow and die. Severely rusted lawns may winter kill.

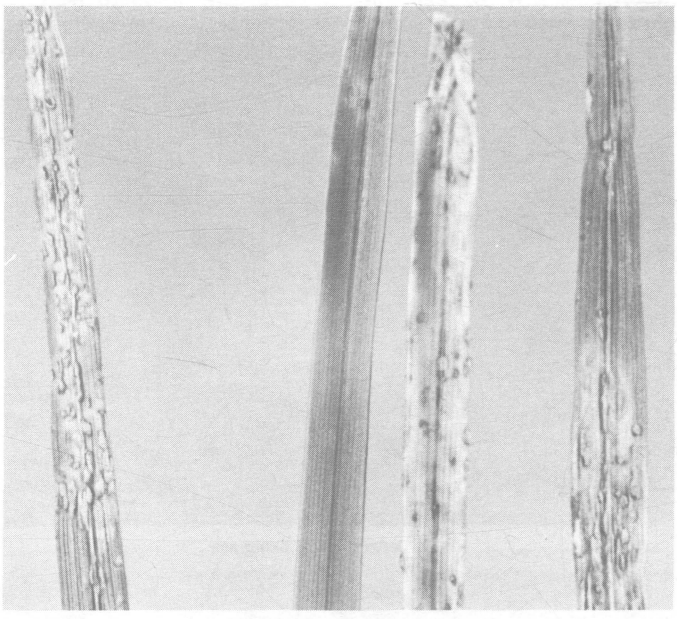


Fig. 5. Rust

Disease Cycle

The cycle of development for this group of organisms is very complex due to the many species and the alternate hosts that are involved. In general, the organisms overwinter as dormant mycelium in infected turfgrass plants or as special overwintering spores (teliospores) in the soil. Teliospores germinate in the spring and go to an alternative host (*Berberis* sp. for

Puccinia graminis f. sp. *agrostis)* where they germinate and infect the upper leaf surfaces. Later in the summer a different spore is produced on the grass that infects other grass plants directly. These spores are disseminated by wind for great distances. In late fall teliospores are produced to complete the cycle.

The disease is usually a problem in August or September following extended hot and dry weather. Alternating conditions of low light intensity, 70 to 75°F temperatures and high humidity for 4 to 8 hours, followed by high light intensity, 85-95°F temperatures and slow drying of leaf surfaces favor the disease. Thus, the problem occurs primarily in late summer.

General Control

1. Use resistant varieties. .Among perennial ryegrasses, Derby and Pennfine are resistant. Most improved varieties of bluegrass are not seriously damaged.
2. Provide adequate water and fertility levels to keep the grass growing vigorously during dry periods.

Dollar Spot or Small Brown Patch

Cause

This disease is caused by the fungus *Sclerotina homoeocarpa* and is most serious on bentgrasses. It also attacks bluegrasses and fescues.

Symptoms

The disease appears as round, brown or bleached spots the size of a silver dollar or somewhat larger (Fig. 6). Individual grass blades are bleached to a straw-colored tan with reddish-brown margins (Fig. 7). When dew is still present on the leaves, a cobwebby white mold-like growth of the fungus appears on affected leaves.

Fig. 6. Dollar Spot of bentgrass

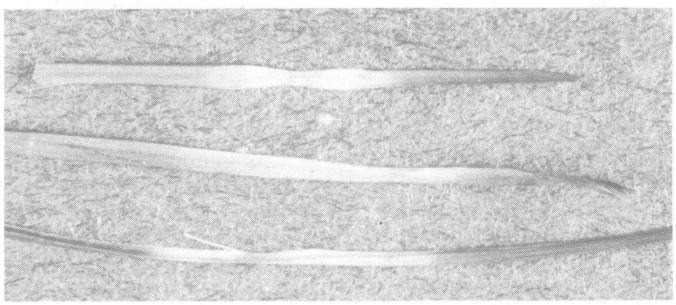


Fig. 7. Dollar Spot

Disease Cycle

The fungus overwinters in or on the soil in the form of hard resting bodies called sclerotia. When temperatures reach 60°F in the late spring or early summer, the fungus begins to grow. It reaches peak activity during humid weather when temperatures range from 70-80°F. The fungus spreads from one area to another on infected material carried on mowers, travelling irrigators, maintenance equipment and shoes.

General Control

1. Provide adequate soil moisture. Grass growing under low soil moisture conditions is more susceptible to this disease.
2. High nitrogen fertility aids in more rapid plant recovery in case of an attack by dollar spot.
3. Dollar spot control must be coordinated with a fungicide program. See Leaflet 187.

Brown Patch or Rhizoctonia Disease

Cause

Brown patch is caused by the fungus *Rhizoctonia solani*. All lawn grasses grown in the midwest are attacked; however, bentgrasses are more seriously injured than the courser bluegrasses and red fescues.

Symptoms

Irregularly shaped brown spots, one inch to several feet in diameter, develop on the turf (Fig. 8). Leaves are at first water-soaked and dark, but soon dry, wither and turn brown in color. On close-clipped bentgrass, a dark purplish "smoke ring" of wilting grass borders the diseased area. This ring is not present when the weather is dry. When present it is often more easily seen in the early morning.

Disease Cycle

The fungus survives the winter as resting bodies (sclerotia) in the soil or as mycelium in grass tissue or soil. It can survive for long periods of time in the soil in the absence of susceptible grass. The fungus begins to grow when air temperatures reach 64°F. When average daily temperatures reach 73°F the fungus can infect the leaf tissue through leaf pores and wounds. When temperatures reach 80-85°F and relative humidity is 100 percent, infection is rapid and turf may be blighted in 6 to 8 hours. At 90°F the fungus stops growing.

Moisture must be present on the leaves for the fungus to spread rapidly to healthy plants. Rainy weather and

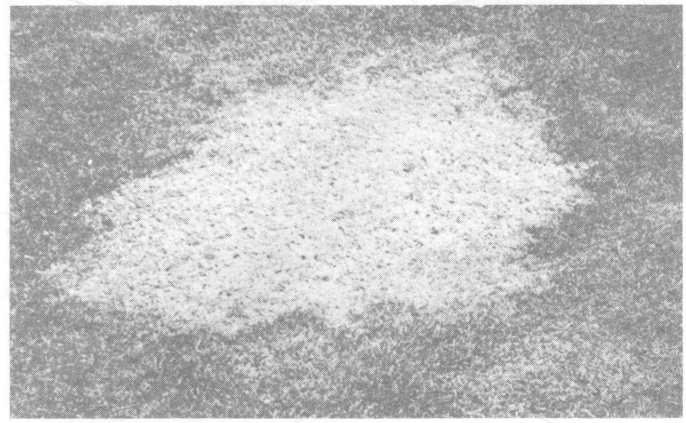


Fig. 8 Brown Patch on bentgrass

excessive irrigation will favor the disease. Soft, lush plants grown under high nitrogen are more susceptible than plants grown at normal, balanced fertility levels. However, plants grown at low levels of N, P, and K are easily attacked.

General Control

1. Four conditions are necessary for the disease to develop: (a) active fungus, (b) dense growth of susceptible grass, (c) prolonged dew or moisture on the foliage, (d) 70 to 90°F temperatures for several hours. If any one condition is lacking, brown patch will not develop.
2. Use resistant varieties. Bentgrasses are very susceptible and cannot be grown without a preventive fungicide program. Meadow fescue, redtop and Merion Kentucky bluegrass are more susceptible than common Kentucky bluegrass or Illahee fescue.
3. Avoid overwatering and high nitrogen fertilization.
4. Increase air circulation by pruning trees and shrubs.
5. Remove clippings.
6. Follow a protective spray program when susceptible varieties are involved. See L-187, Control of Turfgrass Pests.

Pythium Blight, Grease Spot or Cottony Blight

Cause

Pythium blight is caused by two species of the fungus *Pythium, P. aphanidermatum* and *P. ultimum.*

Symptoms

This disease appears as small spots ranging from ½ to 4 inches in diameter. Water-soaked at first, the patches fade to a light brown color as the leaves shrivel. A greasy border of blackened grass blades intertwined with a cottony mass of fungus threads often is found. Streaks in the turf area may often conform to drainage patterns or mowing direction.

Disease Cycle

The *Pythium* organism is capable of surviving in the soil as a saprophyte. In diseased turfgrass, it is present as dormant mycelium. It can grow from plant to plant but transport over longer distance is by equipment, infested soil, and water. *Pythium* is most aggressive at air temperatures of 85 to 95°F and saturated air, thus it is often called a warm, wet weather disease.

General Control

This disease can be difficult to control at times.
1. Maintain good soil moisture levels near field capacity.
2. Maintain proper balance of nutrients but do not stimulate lush growth.
3. Keep soil pH on acid side if possible.
4. When an outbreak develops, use a fungicide program as listed in L-187.

Red Thread

Cause

This disease is caused by the fungus *Corticium fuciforme.* It may be found on all commonly cultivated turfgrass species but is most common on Manhattan ryegrass and the fescues.

Symptoms

In overall view, this disease is seen as irregularly-shaped patches of blighted turfgrass ranging in size from 2 inches to 3 feet in diameter. The disease is confined to leaves and leaf sheath only. Water soaked spots appear first, followed by general drying out of the affected tissue. The tissue fades to a tan color. Under favorable conditions, leaves may be covered with a pink gelatinous and thread-like growth of the fungus. The easiest time to make a diagnosis is when disease is in its final stage of development.

Disease Cycle

The fungus overwinters in dormant structures and can survive for at least two years in the soil. It moves from one area to another in these structures and in infected leaf parts. Disease development is favored by air temperatures in the 68 to 75°F range along with prolonged periods of moisture-saturated atmosphere. Disease severity decreases with increased nitrogen fertility.

General Control

1. Maintain a good fertility program at balanced rates.
2. If the problem is severe, follow a fungicide program as listed in L-187.
3. Mow a bit shorter to promote rapid drying in spring and early summer.

Snow Molds

Cause

Snow molds are caused by several fungi, *Typhula itoana* and *Fusarium nivale* being the most common ones found in turf.

Symptoms

The disease appears as patches of whitish, dead, bleached areas of turf one inch to several feet in diameter (Fig. 9). Several spots may run together forming large, irregular areas (Fig. 10). The leaves of the plants in these infection centers progress from a scalded appearance to a grayish white and finally mat together in the later stages of decomposition.

Fig. 9 Snow Mold

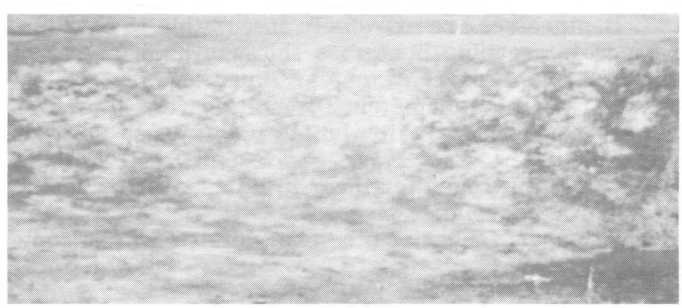


Fig. 10 Several spots Snow Mold run together to form large irregular area

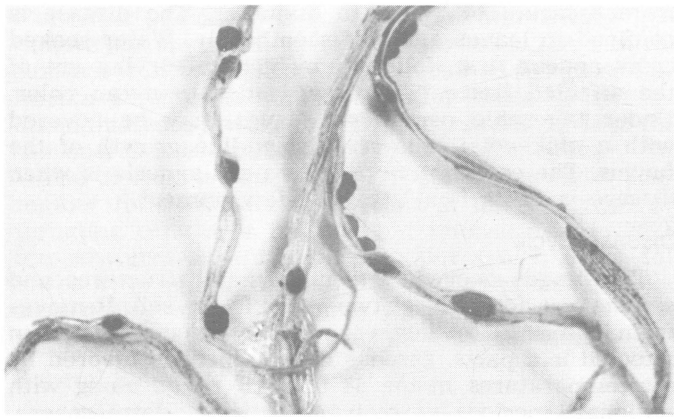


Fig. 11 Typhula Snow Mold

The dead grass takes on a gray white to almost black mold color where *Typhula* is present. Close observation will reveal the presence of fruiting bodies (sclerotia) embedded in the leaves and crown of diseased plants. The sclerotia vary in size from a pinhead up to 3/16 inch in diameter and are yellow or light brown at first, eventually turning dark brown (Fig. 11).

With *Fusarium* patch, the grass becomes a whitish gray and the individual leaves have a bleached appearance and feel slimy when wet. Under snow cover or during prolonged cool, wet weather, the diseased patches may be covered with a mat of aerial fungus threads which are white at first and then turn a faint pink color upon exposure to light, hence the name Pink Snow Mold.

Disease Cycle

The *Typhula* fungus survives the warm summer months as sclerotia. In the absence of light under a snow cover and over an unfrozen ground, the sclerotia germinate to produce mycelia which infect the grass. Best conditions for this organism occur when snow falls on unfrozen ground. There is no fungus activity when the ground is frozen with no snow cover. The fungus can grow in the spring in the absence of snow during periods of cool, wet conditions. Therefore, *Typhula* can be a problem in the spring months.

Fusarium patch survives as fungal threads in infected grass plants or in the debris of previously diseased leaves. Spores are carried to the leaves by air currents. Best conditions exist when snow falls on unfrozen ground. High humidity and air temperature from 36 to 45°F are best but disease can develop up to 65°F. Above 70°F the fungus becomes dormant.

General Control

1. Bentgrasses are extremely susceptible to Typhula. Penncross creeping bentgrass shows a high degree of resistance to Fusarium patch. Bluegrass can be attacked by Fusarium patch if conditions are ideal.
2. Prevent heavy thatch build up and dense grass in late fall.
3. Control nitrogen fertilizer in late summer and fall to avoid a heavy mat of grass.
4. Use snow fences or other barriers to control snow drifting.
5. Mow closely in susceptible areas prior to snowfall.
6. Use chemical protectants in areas where snow mold occurs each year. See L-187 for fungicides to use.

Fairy Rings and Mushrooms

Cause

Fairy rings may be produced by the growth of any one of over 50 different species of mushrooms, toadstools, and puffballs. All lawn grasses are subject to these fungi.

Symptoms

Fairy rings are continuous or interrupted bands or rings of fast-growing, dark green grass, often surrounding a ring of thin or dead grass. The bands may be from 4 to 12 inches wide and the circles 3 to 200 feet in diameter. The rings often spread by increasing in diameter from 5 to 24 inches each year. Fruiting bodies of the fungi often appear in the ring in late summer during periods of high soil moisture (Fig. 12).

Mushrooms, toadstools, or puffballs may occur in one location without the dark green band or circle (Fig. 13). In this case the organism is often limited to a specific spot and may regrow in this one place from time to time without ever spreading out. These are unsightly on a well-manicured lawn. Others are foul smelling and some are poisonous and a menace to children.

Disease Cycle

The fungi that cause fairy ring and mushrooms obtain their food from soil organic matter. Growth begins when the organism in the form of fungal threads or bits of fruiting bodies, or less often as spores, is introduced into a lawn area. If the organism becomes established on the thatch, it will grow from a central point and grow outward equally in all directions, forming a ring. If the organism becomes established in buried wood or rotting tree stumps and roots, it will often remain in this area. Mushrooms will recur from time to time at the same spot until the food supply is consumed.

Fig. 12 Fairy Ring

Fig. 13 Toadstools, mushrooms in turf

General Control

The fungi that cause fairy rings and mushrooms are difficult to control. Several approaches should be considered.

1. Break or mow off the mushrooms.
2. Fertilize lawn to mask the dark green ring.
3. Dig out the rotting wood or stump, if that is the source of food.
4. Dig out the fairy ring 1 foot deep and 18 inches on either side of the ring. Remove infested soil, replace with clean soil and reseed or resod.
5. Fairy rings with bands of dead grass may recover if the soil and thatch is broken up by aerating and copiously watered. A tree root feeder may work to supply the water to the root zone of the turf.

Slime Molds

Cause

Slime molds are primitive fungi that obtain their nutrition from dead organic matter, other microorganisms, minerals and other compounds from the surface of growing plants. When conditions are favorable, they will grow and completely cover the surface of leaves and block out light necessary for plant growth. Several fungi are involved, with *Mucilago spongiosa* and *Physarum cinerum* being the most common.

Symptoms

Plant parts as well as the surface of the soil may be covered with a creamy white to translucent slimy growth. This changes in a few days to pinhead size, reproductive bodies, ash-gray or black, sooty in color, or occasionally yellow (Fig. 14). This is the fruiting stage of a slime mold that can be easily rubbed free from the grass blade. The grass area becomes a dull gray due to these small bodies covering the leaves.

Disease Cycle

The fungi causing this disease survive in the turf area as spores. During cool, moist periods in the spring, summer or fall, the spores absorb water, crack open and a mobile swarm spore emerges. These swarm spores feed on other microorganisms and decaying organic matter. They eventually unite and form a body called a plasmodium. It is this plasmodium or slimy mass that grows on the leaves of the turf. Excessive growth of these organisms may weaken the plant due to light exclusion and allow other organisms to attack the turf.

General Control

1. A well watered, well fertilized lawn provides an ideal environment for these organisms so cultural practices should be adjusted to keep the problem to a minimum.
2. Slime molds will disappear in time if left alone. If they come back again, one can brush the grass with a rake or drag a hose over the lawn or wash with a stream of water from a hose.
3. If the problem recurs consistently in the same area, effective control may be obtained by the application of any good turfgrass fungicide listed in L-187, Control of Turfgrass Pests, under Melting-out Control.

Nematodes

Cause

Nematodes are microscopic, slender roundworms (sometimes called eelworms or nemas). Many genera are present in turf but not all are injurious in northern latitudes. The most common ones in Ohio include *Pratylenchus, Heliocotylenchus, Tylenchorhynchus, Criconemoides, Paratylenchus,* and *Hoplolaimus.*

Symptoms

Nematode infested turf lacks vigor, often appears off-color, yellow, bunchy, and stunted. Grass blades die back from the tips and may be interspersed with apparently healthy leaves. Injured turf may later thin out, wilt and die out in irregular areas. The severity of symptoms varies with the quantity of plant parasitic nematodes feeding on and in the roots. Symptoms may be confused with other turf disease problems or in some cases nematodes may predispose the turf to other disease problems.

Disease Cycle

Nematodes survive in the soil as eggs, cysts, or larvae. With the advent of warm weather in the spring, nematodes become active and feed and reproduce on the grass roots. They penetrate into the roots or suck sap from the root surface. No symptoms are evident on the grass because of lush growth and ideal growing conditions. However, as root damage takes place, the grass roots are confined to the upper layers of the soil. As higher temperatures and lower soil moisture develop, the plants begin to decline. At this time nematode populations are high and symptoms are visible on the turf. As the turf declines, the available food supply decreases and the nematode population goes down. Secondary diseases often attack the weakened plants or wounded root systems and continue to kill the turf.

When the turf grasses fail to respond to fertilizer and water and other problems do not exist, nematodes may be suspected. There are numerous, harmless nematodes in the soil that feed on decaying organic matter and some are beneficial to man.

To be sure parasitic nematodes are a problem, one must collect a soil sample. Samples should be taken within the troubled area at a depth of 4 to 5 inches. At least one pint of soil is needed. This must be put in a plastic bag and kept cool and moist. **Do not dry the sample. Do not overheat the sample.** Sample should not remain in a hot car or truck during the heat of the day. Samples can be refrigerated to keep them cool. Send to the Plant Disease Clinic, 2021 Coffey Rd, Columbus, Ohio 43210 on Monday, Tuesday, and Wednesday. Any later in the week may result in mail delay time and the sample will be of little value for analysis for nematodes.

General Control

1. Maintain good cultural practices.
2. Confirm diagnosis with a plant disease clinic.
3. See disease control guide in Leaflet L-187 for specific chemicals to use.

Algae, Green Scum

Cause

These are small single-celled, filamentous plants which grow on turf or on the soil during favorable conditions.

Symptoms

A greenish or blackish scum forms on thin turf or on bare soil. This slick and slimy scum dries to form a tough crust sealing off the soil, smothering the existing grass and preventing the formation of a dense turf. The crust may dry further, crack and peel, giving the surface a scaly appearance.

Disease Cycle

Algae are present in all turf areas, and when conditions become favorable, they will grow rapidly. Low, wet, shaded or heavily used and compacted areas are more prone to algae development. Algae grow more rapidly in warmer weather but may be found whenever conditions are favorable for the growth of grass. Acidic soil conditions favor their growth.

General Control

1. Correct soil drainage or air drainage. Soil drain tile may be necessary to remove extra water.
2. Reduce foot traffic and compaction. Aerify the soil.
3. Have soil tested and correct acid and fertilizer problems.
4. Prune surrounding vegetation to improve light conditions.

Planning Disease Resistance When Reseeding or Overseeding Lawns

In the fall of the year, many homeowners will be either overseeding or reseeding portions of their lawns. Dense shade that most homeowners experience as their homes grow older has caused a good deal of lawn decline and necessitates the reseeding activities. There are many garden centers now that carry a selection of bluegrass cultivars for people to buy. In addition, there are many blends of bluegrasses already on the market that are designed for homeowner use. Questions always arise as to which of these cultivars should be used.

It is important to get disease resistance into our blend when we are considering either reseeding or overseeding portions of already established lawns. There are several improved Kentucky bluegrasses now available. Many of these are best designed for high maintenance lawns and are quite disease resistant. The important thing to remember is that they will not fare well unless they are given high maintenance lawn programs. Therefore, they are fine for those homeowners who intend to maintain their lawn at high fertility levels and repeatedly use good turf maintenance practices such as irrigation, repeated dethatching, etc.

Cultivars we know are available are A-34, Glade and Nugget as bluegrass cultivars that would be good in shade or partial shade locations. These cultivars have good disease resistance. Other improved bluegrass cultivars that could be used in high maintenance situations include Touchdown, a very aggressive bluegrass cultivar; Parade; Magestic; Fylking; Columbia; Bristol; or Bonnieblue. All these cultivars have fair disease resistance to the common bluegrass diseases likely to occur in lawns in Ohio.

Most lawnowners in Ohio probably will be on a lower maintenance schedule. Therefore, they should consider different kinds of bluegrasses for their reseeding or overseeding situation. Those who are on partial high maintenance programs, kind of in between high and low maintenance, could choose the cultivars Aquilla or Birka. Birka is rated more acceptable in shade areas than Aquilla. Both cultivars have good disease resistance. For the low maintenance lawn, a common type Kentucky bluegrass is best for a reseeding or overseeding program. Some of the better common type bluegrasses on the market include Delta, Park, Kenblue or Couger. Unfortunately, the common types do not have as high a resistance to disease as do the improved types mentioned previously. However, they will do better in a low maintenance program. We believe it would be a better choice to go with these cultivars rather than with the improved cultivars, if the person does not intend to maintain the lawn on a vigorous program. Bluegrass leaf spots and melting out will, of course, be the main disease of concern with these common types of bluegrass.

Be aware that any of these bluegrasses may be difficult to find in any one garden store. The best thing to do is to phone around and find out where they can be purchased, once the decision is made regarding which ones you would like to purchase.

INSECT PESTS OF LAWNS

NOTE: For recommended chemicals and amounts to use, Leaflet 187, Control of Turfgrass Pests, is available through your County Extension Agent's office or direct from The Ohio State University. L-187 lists specific chemical compounds and amounts of each to use in the control of turf pests—weeds, diseases, and insects.

Insect control is very important in the overall care and maintenance of lawns and other turf areas. The homeowner as well as caretakers of industrial and public landscapes must be able to recognize an insect problem, be familiar with the stages of an insect's life cycle during which damage may occur, and know when to apply a treatment for most effective control.

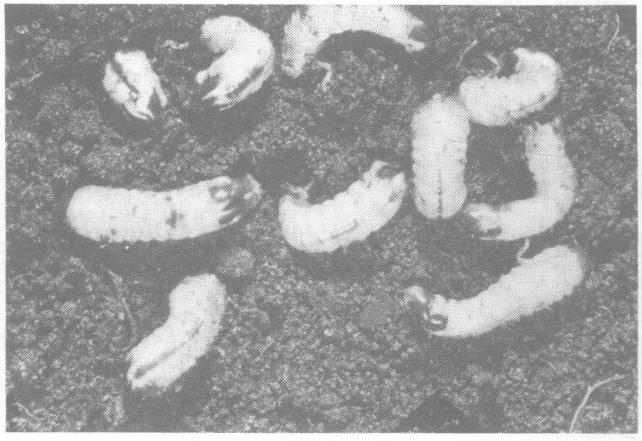
Several of the more important turfgrass insects are discussed in this section. Study them to learn when damage may be expected, how to determine an insect's presence before damage occurs, and when to apply treatments.

White Grubs

Grubworms are the larvae of hard-shelled beetles. They are white to off-white in color and have brown heads. When grass is rolled back, disturbed grubs may be found lying in a C-shaped position in the soil around the root area of the grass.

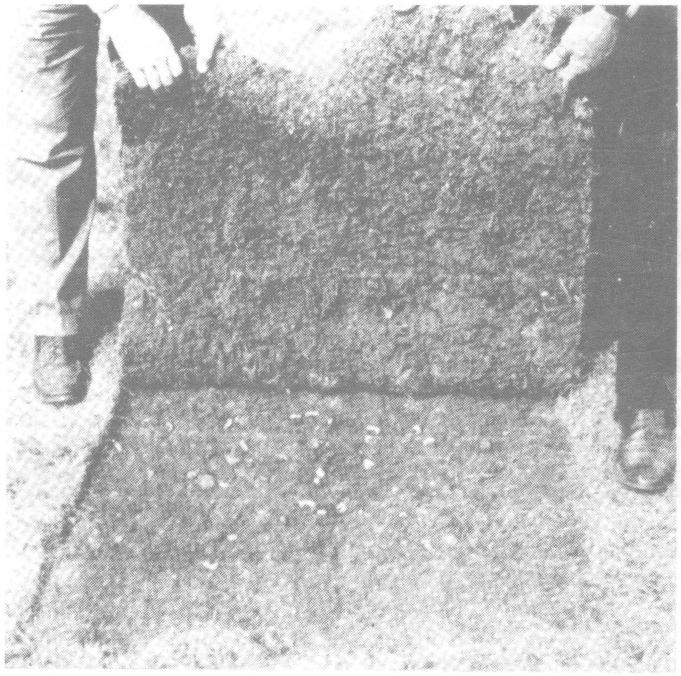
Grubs most common in Ohio and the ones that cause the most damage are Japanese beetles, Northern masked chafer, and June beetle. Damage in lawns by grubs appears as brown patches of dead grass which can be rolled back like a carpet. Generally, damage is noticeable from May on.

Ground mole activity in a yard is a good indication grubs are present, because moles feed on grubs. The best way to tell if you have grubs is to examine the soil from May to September. To do this, cut a foot-square flap on three sides and roll the grass back so soil at the root area can be observed. Do this in several places in the lawn. A treatment is needed when you find an average of 5 to 10 grubs per square foot.



Grubworm Larvae

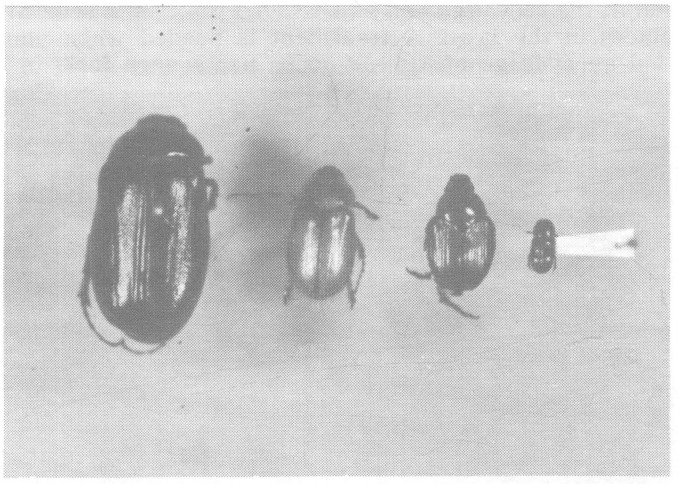
Ground Mole Activity In Grub-Infested Area



Turf Rolled Back To Expose Grubs

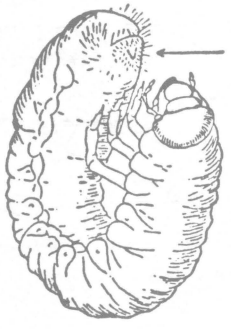
Skunks & Racoons Tear Up Grass For Grubs

Lifting Up Turf To Check For Grubworms



Adult Stage Of Turf Grubworms

L-R, June beetle, Northern masked chafer, Japanese beetle, and Black turfgrass ataenius.



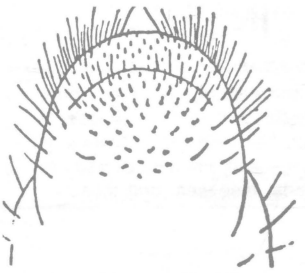
Bottom side of last segment bears the raster

Raster Pattern Helps Identify Grubs

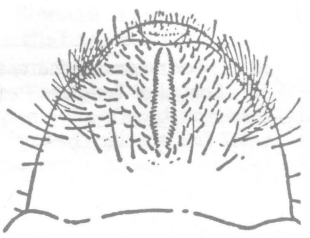
The raster is located on the bottom side of the last segment. It is a series of bristles that form a pattern.

This raster pattern can be a useful tool to identify some of the important grubworms to species.

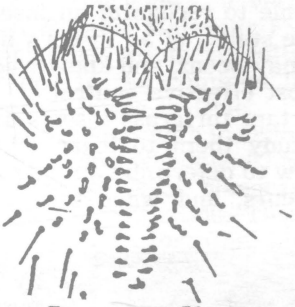
Following are raster patterns for a few of the common and more destructive grubworm species.



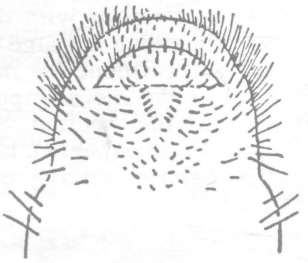
Masked Chafer



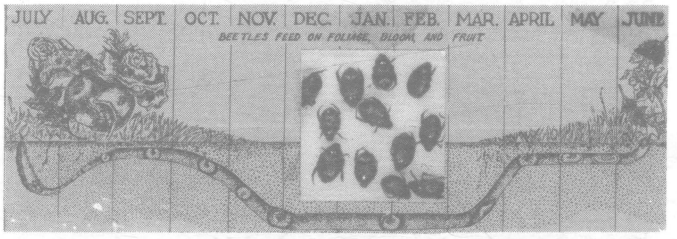
May Beetle



European Chafer



Japanese Beetle



General Life Cycle of A One Year Cycle
Japanese Beetle

The chart shows the stage and location of the Japanese beetle at any one time during the year.

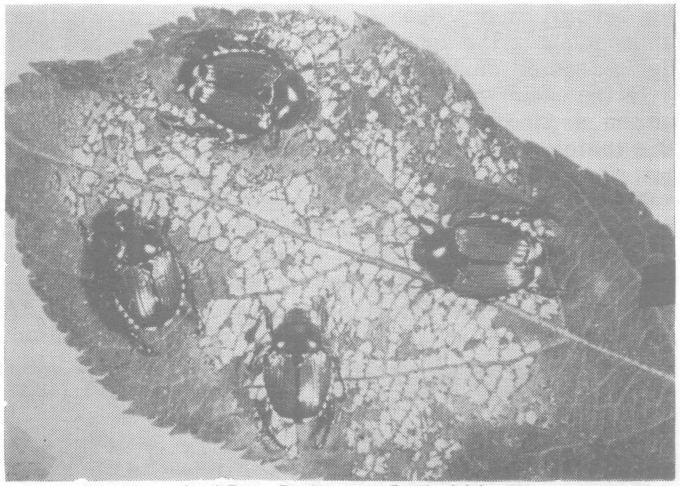
A knowledge of the life cycle will help one know when it is the best time to apply control measures.

Japanese Beetle

The adult Japanese beetle is about ¼ inch wide. The head, thorax, and abdomen are metallic-green, while the hard, outer wings are copperybrown. There are two tufts of white hair on the abdomen just behind the wing covers and five tufts along each side of the body.

Japanese beetles usually appear and start feeding on foliage about the third week in June. These pests are mid-day fliers and their period of greatest activity is from about 9 a.m. to 4 p.m. For a few days after the female beetle emerges, she feeds on foliage. Then she re-enters the turf to lay from one to four eggs. She again emerges, feeds a few more days, and returns to the soil to deposit another batch of eggs. This procedure continues until a total of 40 to 60 eggs have been deposited. All eggs are laid about 2½ inches beneath the soil surface.

Eggs, which are nearly spherical in shape, 1/16 to 1/8 inch in diameter, and white when first laid, change to a cream color before hatching. They hatch into tiny grubs in about 10 days.



Leaf Eaten By Japanese Beetle Adults

Grubs immediately begin feeding on humus in the soil and on the roots of various plants. As the grubs increase in size, they work their way closer to the soil surface where they include grass roots in their diet. Their feeding on the grass roots causes the grass to die out in small patches.

By late September, or as cold weather approaches, the grubs, which have grown to about 1 inch in length and are white to greyish-white, gradually move downward in the soil where they spend the winter. The depth to which they migrate is affected by temperature, soil type, and soil moisture, but usually this depth varies from 6 to 14 inches. In late March or early April of the following year, the grubs again approach the surface of the soil and start feeding on grass roots. In late May, they change into the pupal stage.

The pupa is cream-colored, bobbin-shaped, and about ½ inch in length. It is from this stage that the insect transforms into the adult beetle. Adults feed on some 250 or more plants, including grapes and roses. The life cycle of this species requires one year.

Northern Masked Chafer

The Northern masked chafer is chestnut-brown and is covered with fine hairs. Adult beetles emerge from the soil during the latter part of June and early July. Adults are night fliers in habit and remain in the soil during the day. Unlike the Japanese beetle, they are strongly attracted to light. Careful observations have failed to find adult feeding of any kind.

Female adults begin to lay eggs in the soil within a few days after they emerge from the pupal case. Eggs of this beetle, when laid, are pearly-white and egg-shaped. Most them are laid between 4 and 6 inches below the soil surface. Eggs hatch into tiny grubs in about 20 to 22 days.

These tiny grubs begin feeding on the roots of plants and other organic material in the soil almost immediately after hatching. As the grubs increase in size, they work their way close to the surface where they continue to feed on the roots of grasses. About the middle of October or at the onset of cold weather, grubs begin to descend in the soil where they spend the winter at a depth of 14 to 16 inches. By this time they are about 1¼ inches long. In the following spring, grubs begin to move upward and by early May are feeding close to the surface. In early June they again begin to move downward in the soil but only go to a depth of about 6 inches where they transform to the pupal stage.

The pupa, when newly transformed, is creamy-white and gradually turns to reddish-brown. It spends an average of 18 days in this stage. It is from this stage that the insect transforms into the adult beetle. The life cycle requires one year.

June Beetles

More than 30 species of June beetles, *Phyllophaga* spp., are found in Ohio. The adults of the different species, which vary from light brown to nearly black, emerge from the soil during May and June. Adults feed at night on the foliage of such trees as oak, hickory, walnut, birch, elm, willow, and many others. During the day, they hide in the soil, usually a grass area, where the females lay their eggs.

Eggs of these beetles, when first laid, are pearly-white and elongated. They become swollen and almost spherical 6 to 7 days later. Then they hatch into tiny grubs in about 3 to 4 weeks.

The young grubs feed on decaying and living vegetable matter in the soil during the first summer. As cold weather approaches, they burrow deeper into the soil, remaining there until the spring of the following year when they return near the surface to continue their feeding on the roots of plants.

Grubs feed vigorously and grow rapidly throughout the second summer, causing most of the damage to turf during this year. About mid-October, they burrow into the soil to spend the second winter. In the following spring they move to the surface once more and feed for a month or two on the roots of grasses and other plants. About the middle of June they move downward in the soil and change to the pupal stage. After spending a month as pupae, they change to adults but remain in their pupal chamber throughout the fall and winter and emerge as adults the following May and June.

Female beetles begin to lay eggs in the soil shortly after emerging, thus starting another cycle.

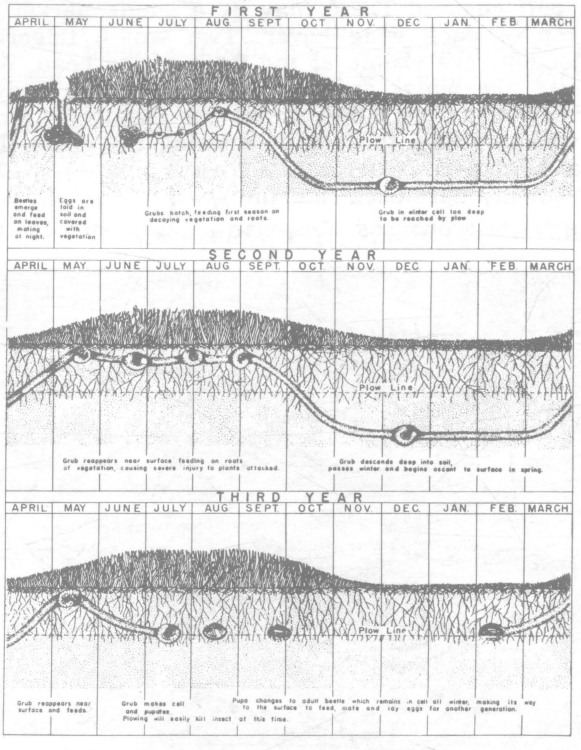


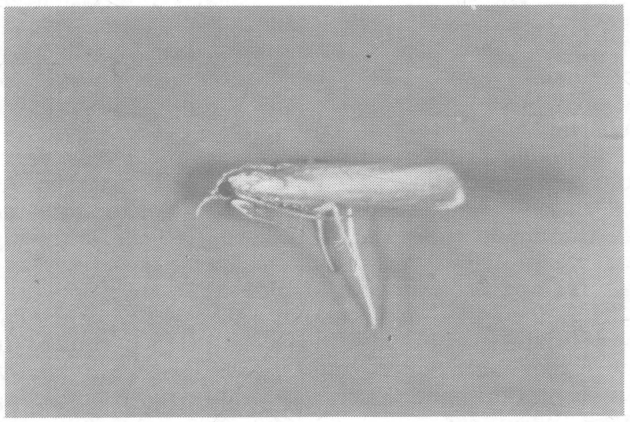
Chart Showing Unusual Life Cycle of June Beetle

Timing of Treatment

Apply any one of the recommended insecticides listed under grubworm control in L-187, Control of Turfgrass Pests, in late March or early April, or in the fall before the ground freezes. Water the lawn after treatment. Keep pets and children off the lawn until it has had a chance to dry.

Sod Webworm

The sod webworm is one of the more destructive pests of bluegrass. Damage to grass results during the period larvae or worms are feeding. The adult moth does not cause damage.

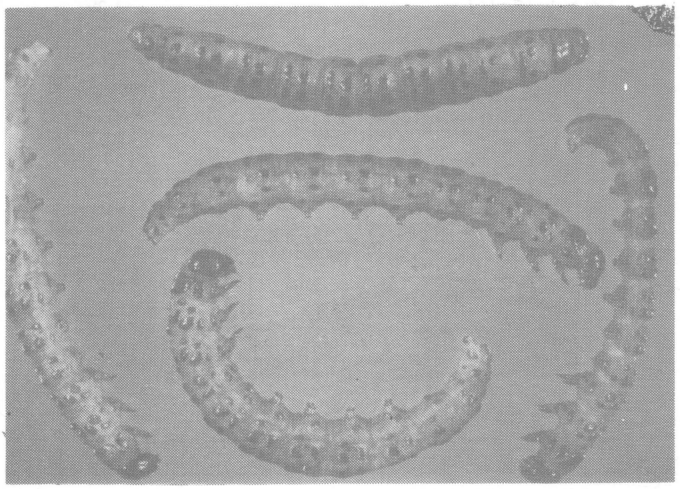


An Adult Sod Webworm

Larvae are generally about 1 inch long, when full grown, by ⅛ inch in diameter. Color of the larva is a dirty, yellowish-white and it has a light brown head. At least four parallel rows of small dark spots run from head to tail. Webworm larvae lie in a curled position in the thatch of the grass.

Adult webworms are about ¾ inch long, cigar-shaped, and buff colored. There may be a small, darker line on top of each wing cover. Two small, finger-like projections are visible at the front of the head. When at rest, the wings are wrapped around the body to form a half circle. Adult moths can usually be kicked up when walking through or mowing the grass. They fly a short distance across the lawn in a zig-zag pattern and quickly dart back into the grass.

Partially grown sod webworm larvae spend the winter several inches deep in the soil. As warm weather approaches in the spring, the larvae move upward and begin feeding on the lush spring growth of grass.



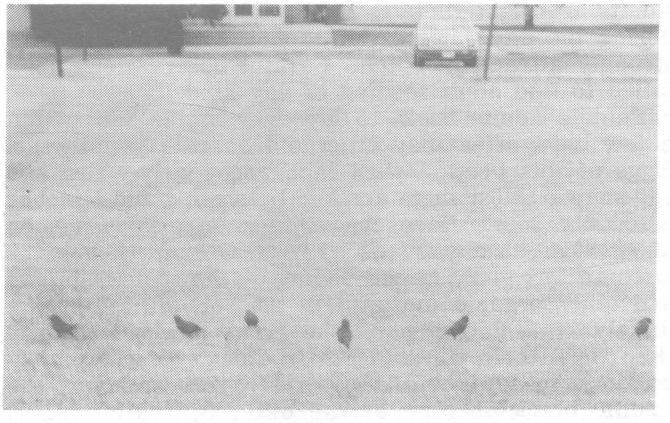
Fullgrown Sod Webworm Larvae

In the spring and summer, sod webworm larvae live on the surface of the soil in small silken tunnels among the thatch of the grass. They chew grass blades off just above the thatch line, pull the blades into their silken tunnels, and eat them. Injury, therefore, appears as small brown patches of close-clipped grass about the size of a softball. When many larvae are present, the small brown patches run together and form large irregular dead patches.

Small Dead Patches & Webworm Larva

During June some of the larvae complete their development and change to the pupal or resting stage. By late June and early July, adult moths emerge from the pupae, pair up, mate, and females soon begin laying eggs, at random, in lawns for another generation. At least two generations, and possibly three, are produced in one year. The second generation, which appears in late August, may cause the most damage.

When the temperature remains below 40 degrees F. in the fall, most of the larvae have already gone down in the soil to overwinter.



Blackbirds Searching For Webworm Larvae

Where webworms are abundant, numerous small holes about the diameter of one's finger are often found randomly spaced in the dead patches of grass. These holes generally extend down to near the soil line. They are made by blackbirds seeking out the larger sod webworm larvae.

Timing of Controls

Control measures are directed at the larvae, so the best time to treat is when the majority of the eggs have hatched and small larvae are present but before excessive damage occurs. Most people want to do something when they see many moths flying at night or when they kick them up in the daytime. When you see moths, this means the larvae have completed their development. **The time to treat is about two weeks after a sharp decline in the number of moths is seen.** At this time, the eggs that were laid by the flying moths should have hatched and a new batch of larvae will be feeding in the lawn.

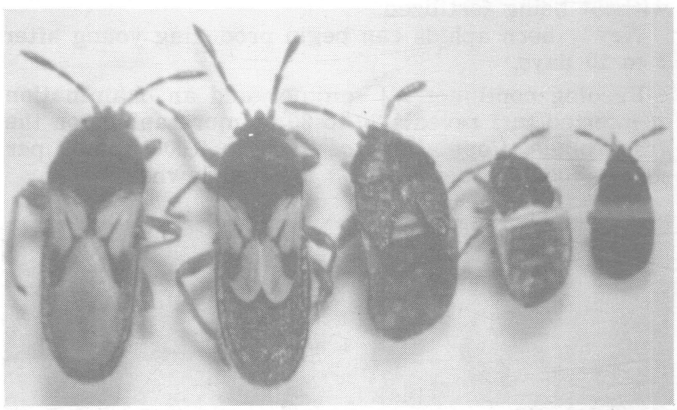
Generations of the webworm do overlap; therefore, some adults and larvae will be present nearly all summer.

In Ohio, the best timing of control applications is once in mid-June and again in early August. Use materials listed for sod webworms in **L-187, Control of Turfgrass Pests.**

Chinch Bugs

Hairy chinch bugs are serious pests of lawns in Ohio. They are more likely to be more serious in lawns containing bentgrass; however, bluegrass is also attacked. Damage to lawns by chinch bugs is caused by the young bugs or nymphs. These bugs, when full grown, are about ¼ inch long and black with a white spot on their back between their wings. They suck juices from the grass, causing it to turn brown and eventually die. Chinch bug infested lawns may have many large, irregular dead patches. Look for the bugs in the circle of grass which has turned yellow around these dead patches.

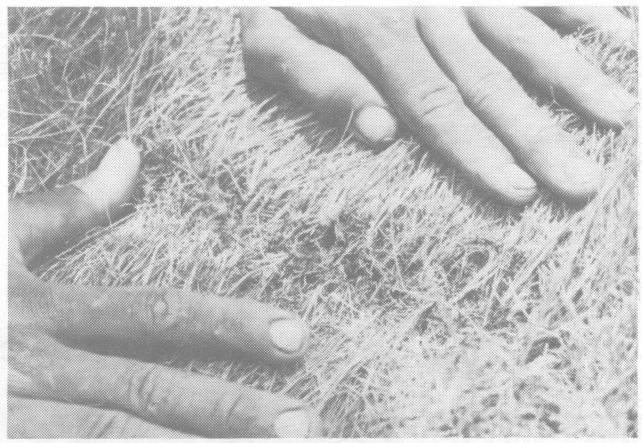
Two generations of chinch bugs appear annually in Ohio with numphs being present in the lawn the last half of June, first generation, and again the last half of August for the second generation.



Nymphs & Adults of The Chinch Bug

Timing of Controls

Two treatments are probably needed to keep the damage to a minimum in lawns where the insect is a problem. Apply the first treatment about June 10 to 20 and the second about August 10 to 20. Because the bugs are usually concealed in the thatch, it is best to water the lawn before applying a treatment. Use any one of the insecticides listed under control of chinch bugs in **L-187, Control of Turfgrass Pests.**



Parting Grass To Check For Chinch Bugs

Bluegrass Billbug

The bluegrass billbug, *Sphenophorus parvulus* Gyllenhall, is not a new pest in Ohio lawns. It has been here for many year. However, 1971 was the first year in which it appeared in damaging numbers over a large area of the state.

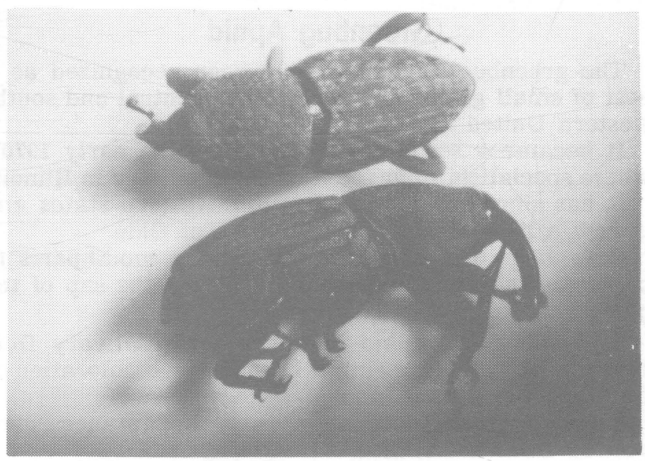
Bluegrass billbugs overwinter as adult weevils. In early spring, they come out of hibernation and begin laying eggs in the stems of grass. The eggs hatch and larvae feed in the stems, gradually feeding their way down into the crowns of the grass plants. By mid-July, some of the larvae have completed their development and begin to change to the pupal stage. This occurs an inch or so below the soil line. Adults can be found in the soil the latter part of July and during August. By September, most adults are present and may be seen walking on hard surface areas around the home.

Damage caused by the billbug shows up as small, dead patches in the lawn during July and August. Billbug damage can be distinguished from sod webworm or chinch bug damage by merely grasping the dead grass plants and pulling firmly on them. If damage is caused by the billbug, plants will break off at the soil line and a sawdust-like material will be present at the broken end.

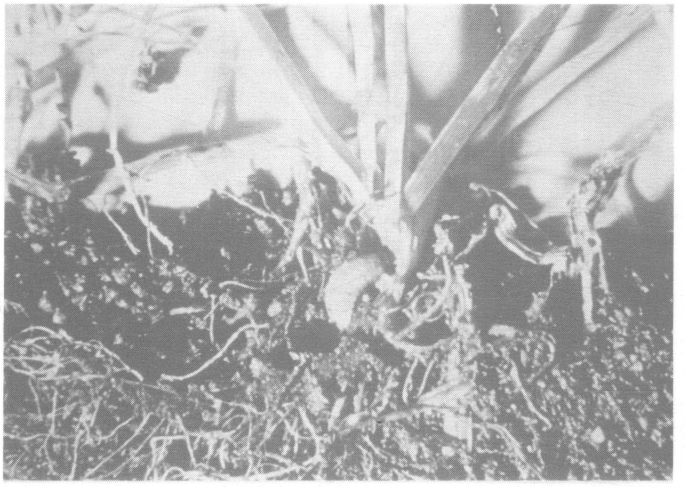
There is only one generation of billbugs per year.

Timing of Control

To control billbug adults, apply approved insecticides



Bluegrass Billbug Adults



Billbug Larva Feeding In Crown of Grass Plant

Greenbug Aphids On A Grass Blade

Grass Roots Exposed To Show Sawdust-Like Debris

listed in **L-187, Control of Turfgrass Pests,** just before the eggs are laid. In Ohio, this is about late March to early April. Control of adults is recommended because once the eggs have been laid, insecticides are ineffective against the larvae in the grass stems. Larvae can be controlled after they migrate to the soil with regular grub proofing insecticides. This control method will reduce the grub population for the next year but will not reduce the damage for the current season. Apply insecticide to control larvae about June 1 to 15.

Greenbug Aphid

The greenbug aphid has long been recognized as a pest of small grains and sorghum in central and southwestern United States.

It became a serious pest of turf in the early 1970's where specialists reported it causing damage in Illinois.

It has since spread to other mid-western states and is now a pest of bluegrass in most of Ohio.

Greenbugs use their piercing-sucking mouthparts to penetrate the grass blades and suck out the sap of the phloem.

In feeding, the aphid injects a toxic salivary fluid into the leaf cells causing a burnt-orange coloration to occur on the grass blade.

Infested grass takes on a rusty appearance when viewed from a distance.

Greenbug infestations often occur beneath a tree, but open areas of grass become infested too.

The exact relationship of the tree and the aphid isn't quite clear. It is clear that the aphids do not feed upon trees or drop from them to the turf.

The greenbug aphid is a soft-bodied insect about 1/16 inch long, light green with a darker green stripe down the back. Two short tube-like structures project from the back end. The legs and the tubes (cornicals) are tipped with black.

The life cycle of the greenbug aphid on small grains and sorghum is well known, but it is not well known on bluegrass.

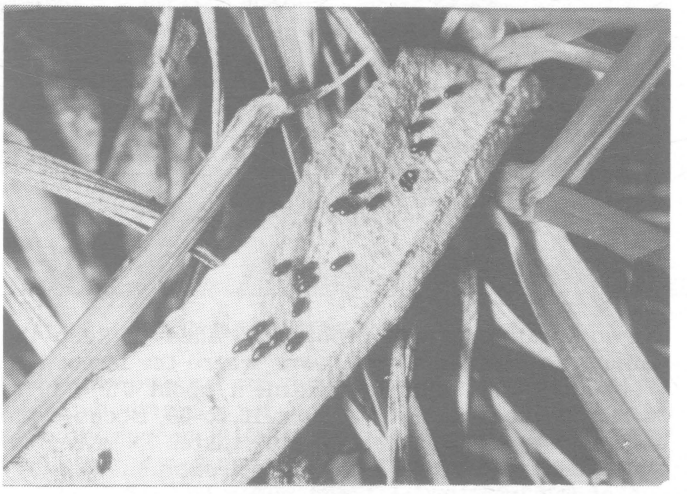
How it gets started each spring and summer in Ohio lawns isn't fully understood. Eggs have been found in late fall, which means it could possibly over-winter as an egg.

Some specialists also know that the insect arrives northward on wind currents.

After it appears on bluegrass and feeds, it isn't long before the greenbugs are giving birth to living young without being fertilized.

Newly born aphids can begin producing young after 7 to 10 days.

Feeding continues all summer and an examination of infested turf reveals 20 to 30 or more aphids on the grass blade. Populations of 2,000 to 3,000 aphids per square foot are common on infested lawns.



Greenbug Aphid Eggs On Bluegrass

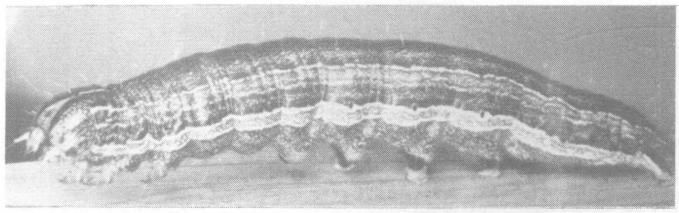
When To Treat

Spray when an examination of grass reveals greenbug aphids or their damage. This generally shows up from the base of a tree but not always. Observe browning grass with a rusty cast. Damage appears in early summer and continues to November. Spray the grass thoroughly with at least 6 gallons of spray mixture and repeat at 5 to 7 day intervals until no greenbugs are seen.

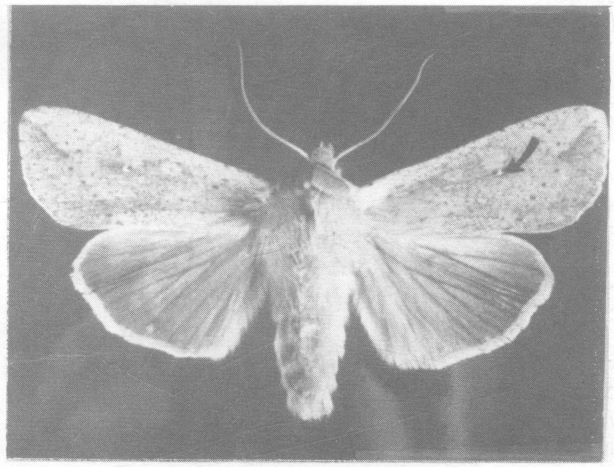
Cutworms

Cutworms are the larval stage of night-flying moths. The caterpillars are smooth, nearly naked, dull-colored and marked with spots and stripes. They vary in length from 1 to 2 inches when fully grown. Cutworms feed mostly at night and are present in the lawn from spring until late summer. They damage the grass by chewing off the blades and sometimes the entire stem to the soil line, leaving deep, dead patches in the lawn.

When cutworms are a problem in the lawn, use any one of the materials listed for grub control in L-187, Control of Turfgrass Pests. Apply insecticide in late afternoon for best results.



Cutworm Larva Found In Turf



Typical Cutworm Adult

Moles

Even though the mole is not an insect, it does cause considerable damage to lawns, and insect larvae are the reason moles infest lawns. Grubs are one of their main sources of food. So, if you get rid of the grubs, you'll get rid of the moles.

Moles can be controlled with baits or traps, but as long as grubs are present, moles will continue to infest the lawn. Use control materials listed under grub control in L-187, Control of Turfgrass Pests.

Use Pesticides Cautiously

Protect yourself and your children, pets, bees, and birds by reading the label and following all directions and precautions.

1. Always read the label before using a pesticide. Note warnings and cautions each time before opening the container. *Read and follow directions for use.*
2. Keep pesticides away from children, pets, and irresponsible people.
3. Store pesticides in a secure place in their original labeled containers.
4. Do not smoke while using pesticides.
5. Do not breathe spray mist or dust.
6. Do not get pesticides in eyes, or skin, or on clothing. If spilled on skin or clothing, wash thoroughly with soap and water and change clothes.
7. Wash hands and face thoroughly before partaking of food.
8. Dispose of empty containers so they pose no hazard to humans, animals, or valuable plants.
9. Sweep dusts or granules from sidewalks and driveways.
10. Use a hose to thoroughly water-in any *insecticide* application so that residues do not remain on the grass blades or the granules or dusts remain on the surface of the ground. However, certain *herbicides* and *fungicides* should remain on foliage for effectiveness. Follow direction on label.